Lesson Module Status

- Slides – draft
- Properties - done
- Flash cards –
- 1st minute quiz – done
- Web calendar summary – done
- Web book pages – done
- Commands –
- Lab – email out tech file, turn on link -
- Supplies ()
- Email tech to class -
- Class PC's – na
- Scripts () – done

Quiz

Please close your books, turn off your monitor, take out a blank piece of paper and answer the following questions:

- What command shows the current running processes?
- Name four states a process can be in.
- What is the difference between the fork and exec system calls?

vi editor

Objectives	Agenda
• Create and modify text files	• Quiz • Questions from last week • Test results • grep • Review on processes • vi • Wrap up

✵ = hands on exercise for topic

Housekeeping

Previous material and assignment

1. Questions?

2. Lab 8 due at midnight

```
$ at 11:59pm
at> cat files.out bigshell > lab08
at> cp lab08 /home/rsimms/cis90/$LOGNAME
at> Ctrl-D
```

Don't wait till Thursday to see if this worked! Test with an earlier time.

3. Note: Lab 9 and five posts due next week

Test Answers

Grep

(can use for Lab 8)

grep usage

What is my account information in /etc/passwd?

```
/home/cis90/roddyduk $ grep $LOGNAME /etc/passwd
roddyduk:x:1000:103:Duke Roddy:/home/cis90/roddyduk:/bin/bash
```

or

```
/home/cis90/roddyduk $ cat /etc/passwd | grep $LOGNAME
roddyduk:x:1000:103:Duke Roddy:/home/cis90/roddyduk:/bin/bash
```

My password is kept in /etc/shadow, my user ID is 1000, my primary group ID is 103, my full name is Duke Roddy, my home directory is /home/cis90/roddyduk, my shell is /bin/bash

grep usage

Is the CUPS daemon (print service) running right now?

```
/home/cis90/roddyduk $ ps -ef | grep cups
root      2588     1  0  2008 ?        00:00:00 cupsd
roddyduk  5893  5496  0 07:01 pts/3    00:00:00 grep cups
```

Yes it is, with pid=2588

grep usage

Is Samba (File and Print services) installed?

```
/home/cis90/roddyduk $ rpm -qa | grep samba
system-config-samba-1.2.39-1.el5
samba-client-3.0.28-1.el5_2.1
samba-3.0.28-1.el5_2.1
samba-common-3.0.28-1.el5_2.1
/home/cis90/roddyduk $
```

Yes, the client, server and common packages have been installed already

grep usage

How many CIS 90 user accounts are there?

```
/home/cis90/roddyduk $ cat /etc/passwd | grep :103: | wc -l
28

/home/cis90/roddyduk $ cat /etc/passwd | grep cis90 | wc -l
28
```

*There are 28. The cis90 group is GID 103, the home directories are /home/cis90/**

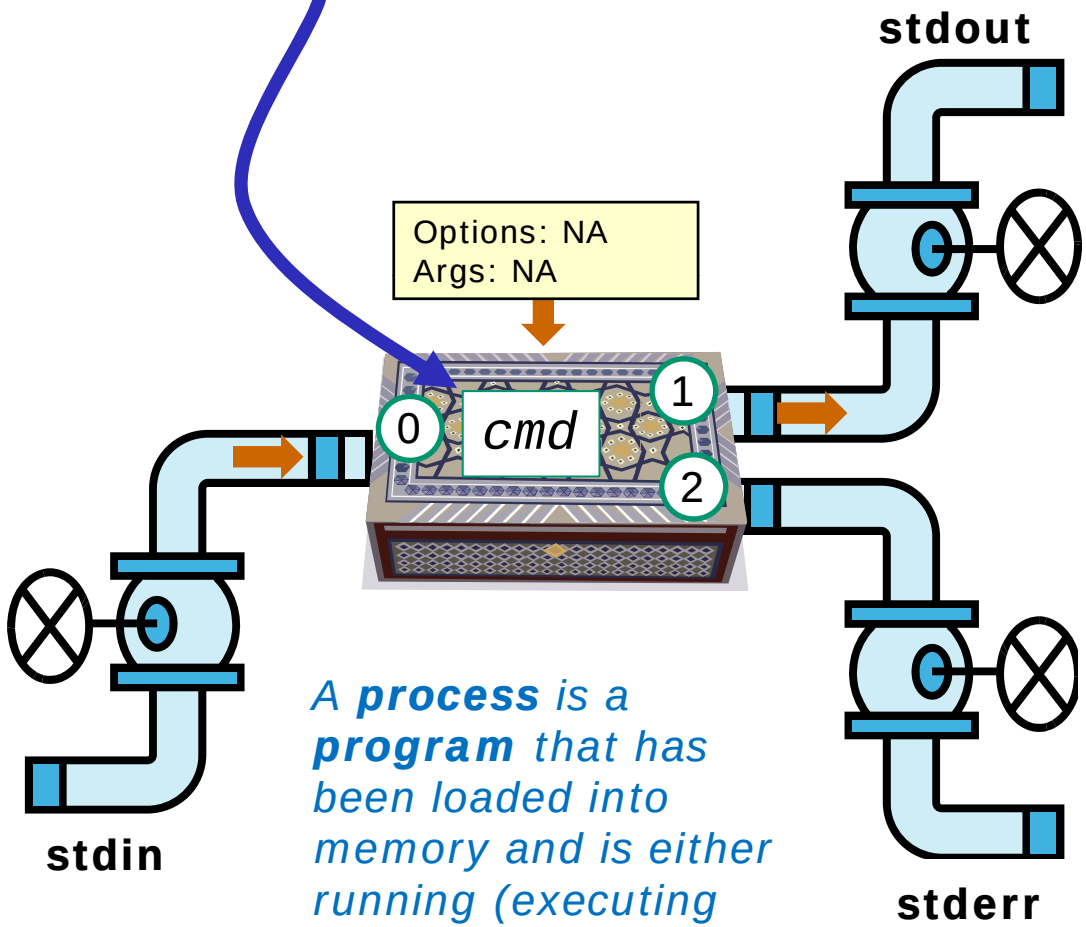
grep practice

- How many CIS192 accounts are there?
- Is the cronjob daemon (crond) running right now?
- Is the mysql package been installed on Opus?

Review of Processes

Program to process

```
/home/cis90/roddyduk $cmd
```



*A **process** is a **program** that has been loaded into memory and is either running (executing instructions) or waiting to run*

A Process at Work

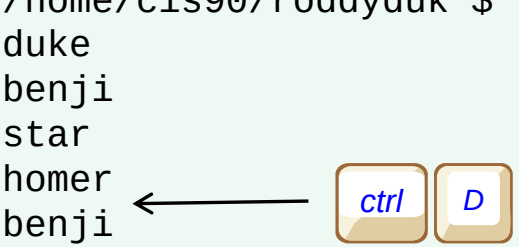
A **process**
- reads from **stdin**
- writes to **stdout**
- puts error messages in **stderr**

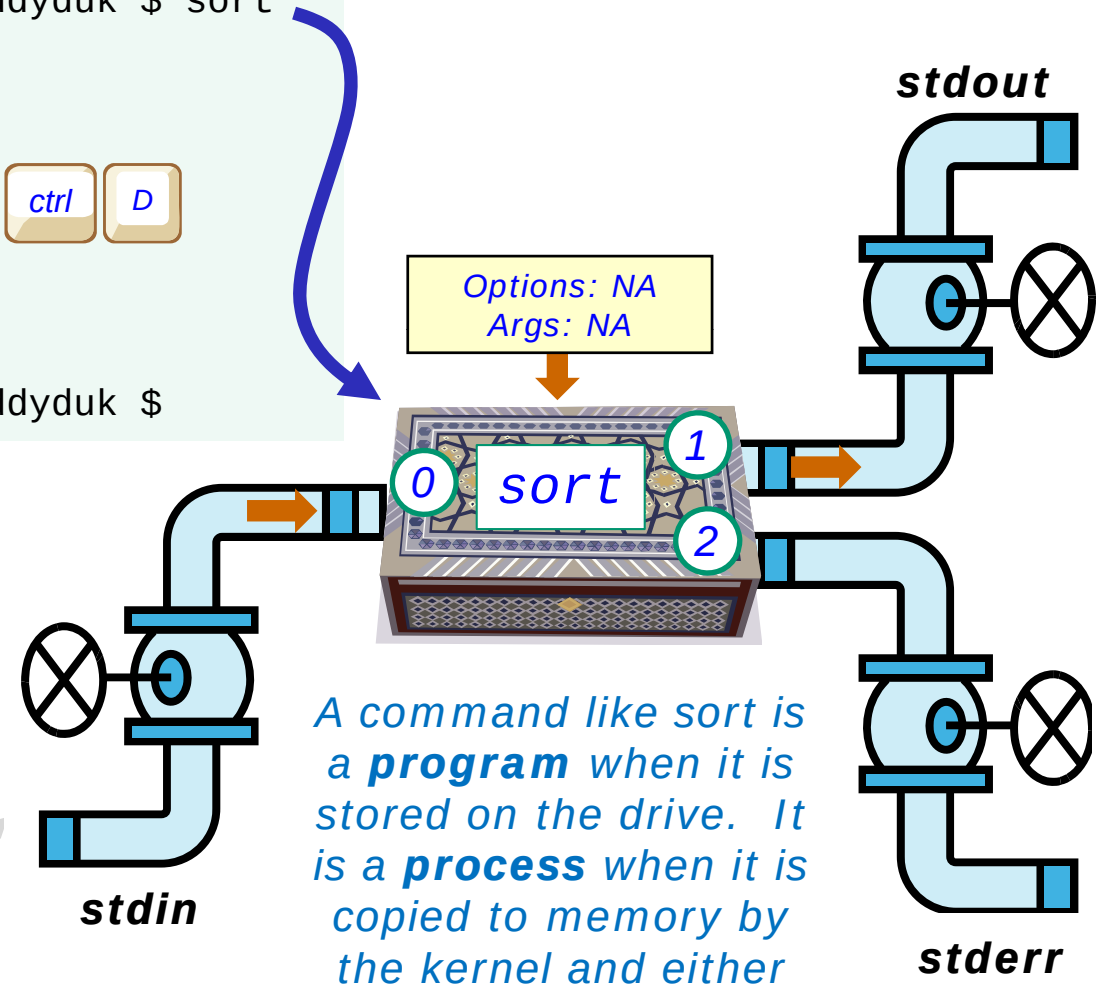
- and may get interrupted from time to time by a **signal**

*A **process** is a **program** that has been loaded into memory and is either running (executing instructions) or waiting to run*

Example program to process: sort command

```
/home/cis90/roddyduk $ sort
duke
benji
star
homer
benji
duke
homer
star
/home/cis90/roddyduk $
```





/dev/pts/0

benji
duke
homer
star

/dev/pts/0

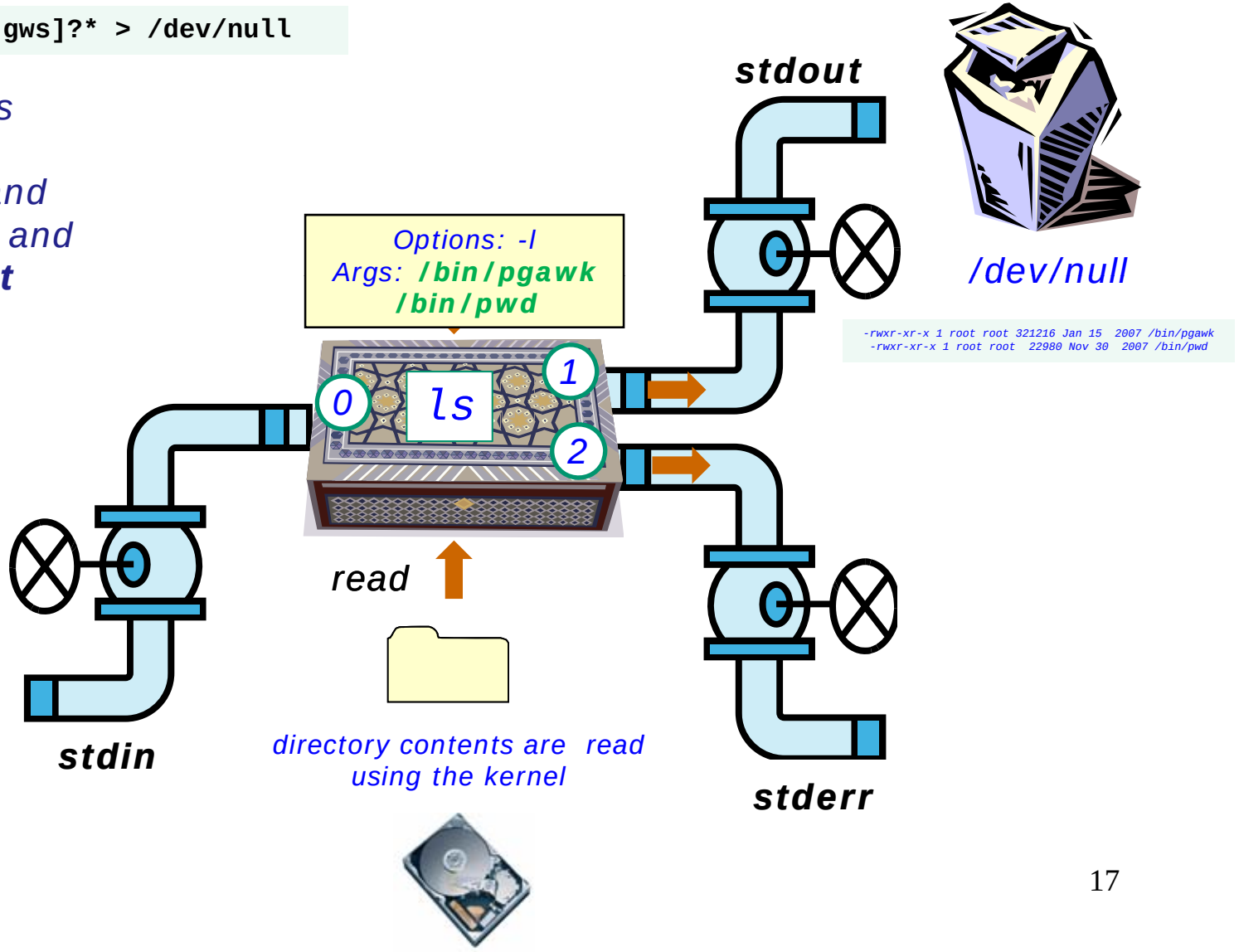
duke
benji
star
homer

A command like sort is a **program** when it is stored on the drive. It is a **process** when it is copied to memory by the kernel and either running or waiting to run.

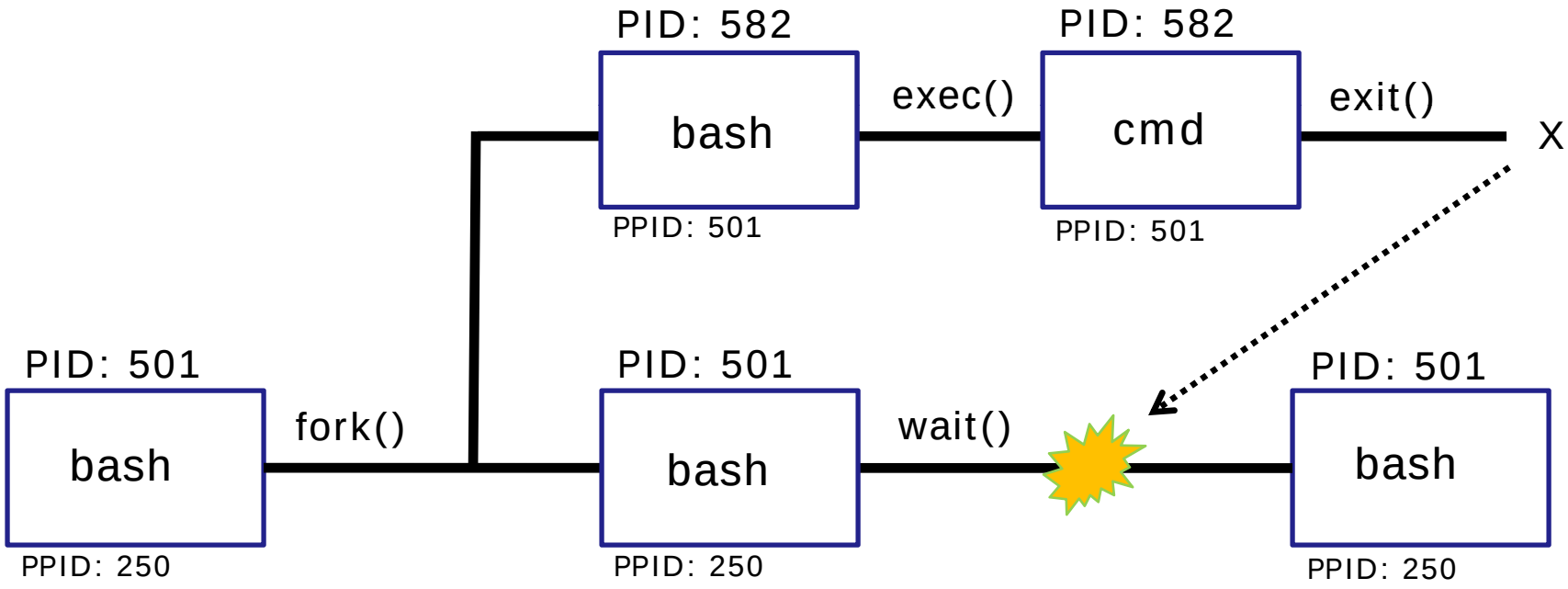
example program to process

```
$ ls -l /bin/p[gws]?* > /dev/null
```

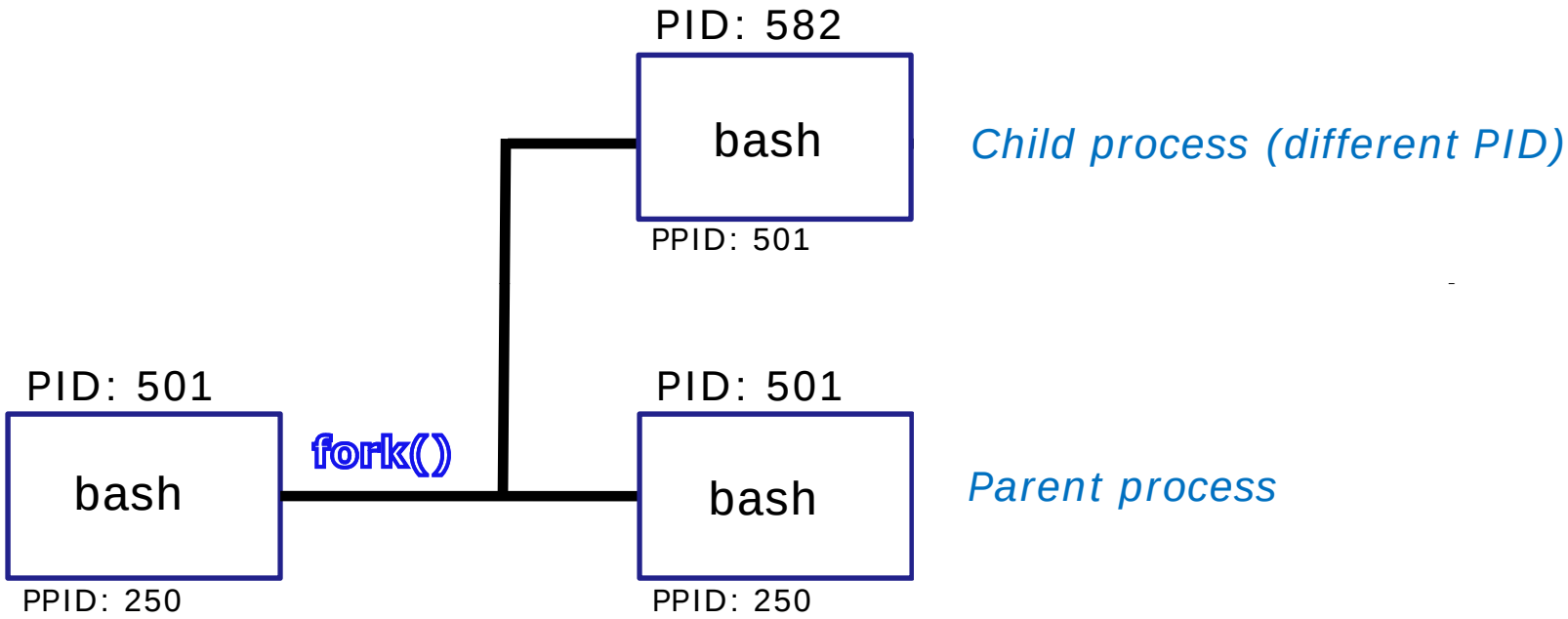
*Note: ls gets its input from the command line and the OS (kernel) and writes to **stdout** (redirected to /dev/null) and **stderr**.*



Process Lifecycle



Process Lifecycle

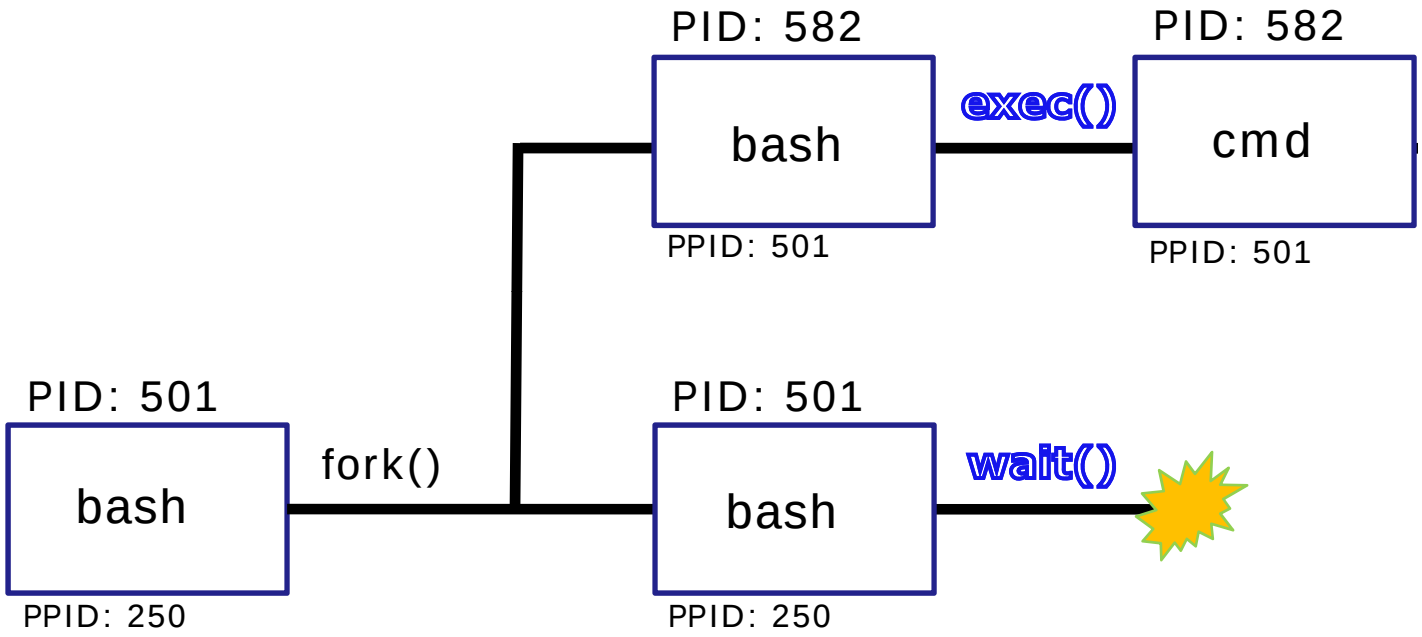


1) When a program is loaded into memory a new process must be created.

*This is done by the **parent** process (bash) making a copy of itself using the fork system call.*

*The new **child** process is a duplicate of the **parent** but it has a different PID.*

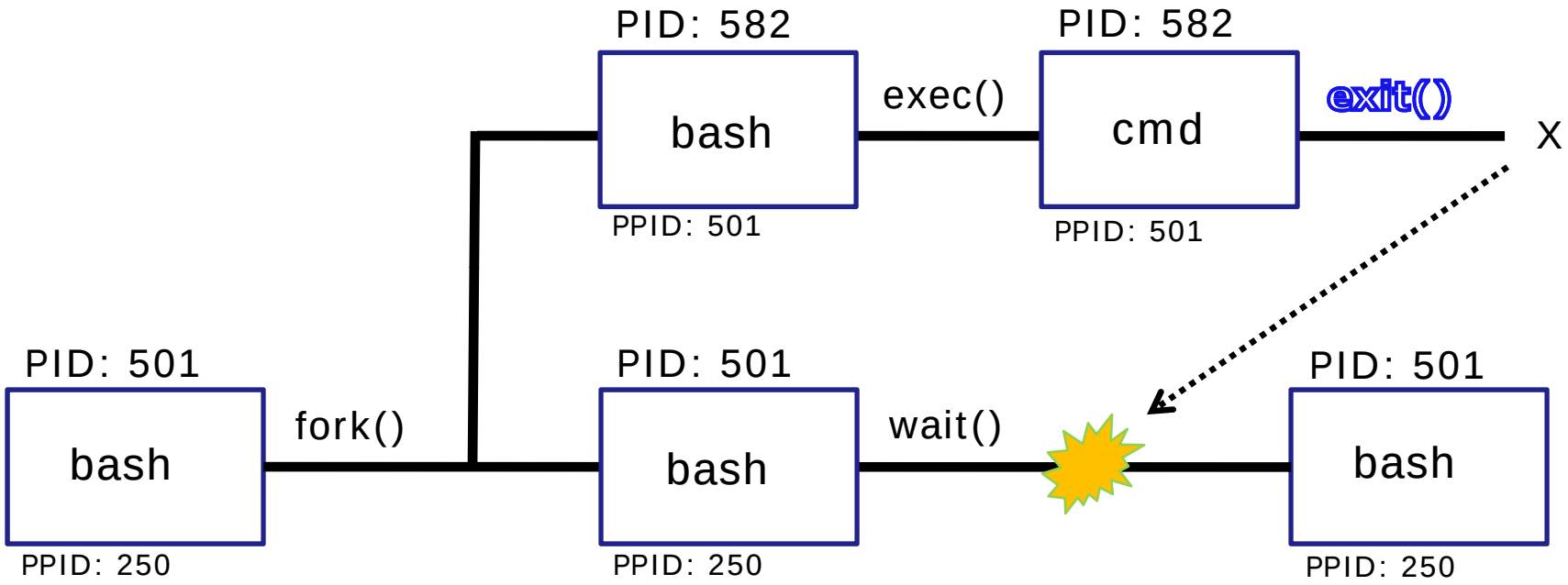
Process Lifecycle



*2) An exec system call is issued to overlay the **child** process with the instructions of the requested command. The new instructions then are executed.*

*The **parent** process issues the wait system call and goes to sleep.*

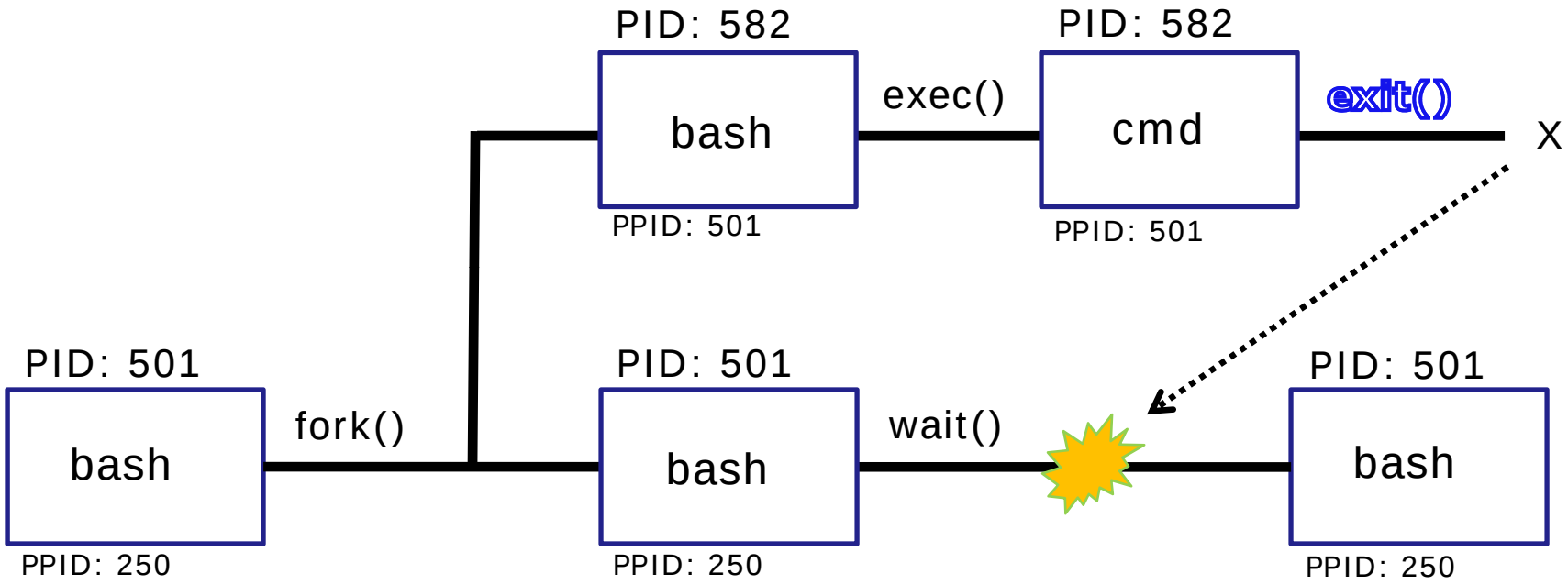
Process Lifecycle



*3) When the **child** process finishes executing the instructions it issues the exit system call. At this point it gives up all its resources becomes a **zombie**.*

*The **parent** is woken up and once the **parent** has informed the kernel it has finished working with the **child**, the **child** process is killed and removed from the process table.*

Process Lifecycle



*3) If the **parent** process were to die before the **child**, the zombie will become an **orphan**. Fortunately the init process will adopt any orphaned **zombies**.*

Parent and child process practice

- Type **bash**
- Type **bash** again
- Type **bash** again
- Type **ps –l**
- Who is the parent of ps? Who is the parent of the parent of ps?
- Type **ps –ef**
- Track your family history as far back as you can go. Who is the most distant grandparent of ps?

Review of Signals

Signals

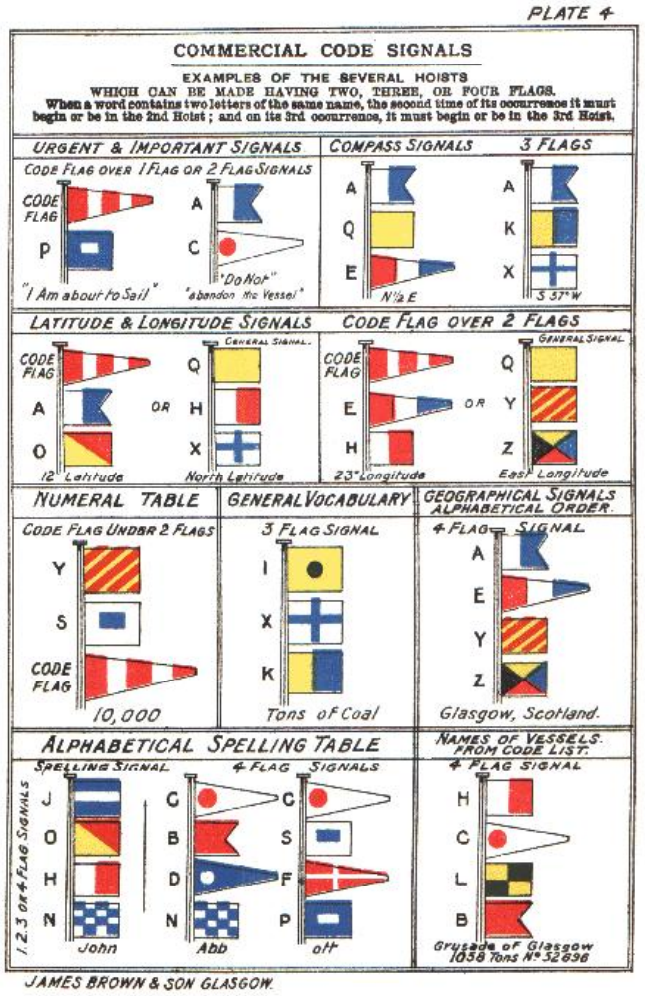


PLATE 4

COMMERCIAL CODE SIGNALS

EXAMPLES OF THE SEVERAL HOISTS WHICH CAN BE MADE HAVING TWO, THREE, OR FOUR FLAGS.

When a word contains two letters of the same name, the second time of its occurrence it must begin or be in the 2nd Hoist; and on its 3rd occurrence, it must begin or be in the 3rd Hoist.

URGENT & IMPORTANT SIGNALS — CODE FLAG OVER 1 FLAG OR 2 FLAG SIGNALS

CODE FLAG P — "I Am about to Sail"

A C — "Do Not" "abandon the Vessel"

COMPASS SIGNALS — 3 FLAGS

A Q E — N½E

A K X — S 37° W

LATITUDE & LONGITUDE SIGNALS — CODE FLAG OVER 2 FLAGS

CODE FLAG A O — 12° Latitude

OR Q H X — North Latitude

CODE FLAG E H — 23° Longitude

OR Q Y Z — East Longitude

NUMERAL TABLE — CODE FLAG UNDER 2 FLAGS

Y S CODE FLAG — 10,000

GENERAL VOCABULARY — 3 FLAG SIGNAL

I X K — Tons of Coal

GEOGRAPHICAL SIGNALS ALPHABETICAL ORDER. — 4 FLAG SIGNAL

A E Y Z — Glasgow, Scotland.

ALPHABETICAL SPELLING TABLE — SPELLING SIGNAL — 4 FLAG SIGNALS

1.2.3 or 4 FLAG SIGNALS

J O H N — John

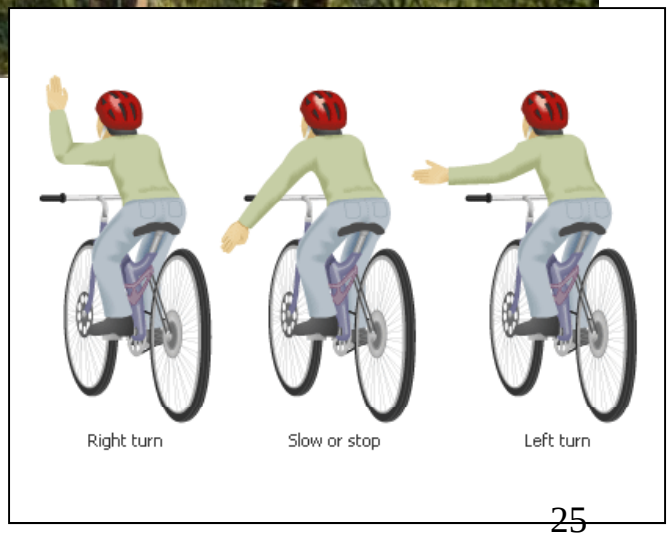
C B D N — Abb

C S F P — off

NAMES OF VESSELS FROM CODE LIST. — 4 FLAG SIGNAL

H C L B — Crusade of Glasgow 1858 Tons No 32696

JAMES BROWN & SON GLASGOW.



Signals

Signals are asynchronous messages sent to processes

They can result in one of three courses of action:

1. be ignored,
2. default action (die)
3. execute some predefined function.

How are signals sent?

Signals

Signals are asynchronous messages sent to processes

They can result in one of three courses of action:

1. be ignored,
2. default action (die)
3. execute some predefined function.

Signals are sent:

kill command

Using the kill command: **`$ kill -# PID`**

- Where # is the signal number and PID is the process id.
- if no number is specified, SIGTERM is sent.

Using special keystrokes

- limited to just a few signals
- limited to when you have control of the keyboard

Use kill –l to see all signals

Signals

The result of sending a signal to a process:

- be ignored
- default action (die)
- execute some predefined function

BTW, is signal 18 really a signal?

Tangent on bg and SIGCONT

Signals

What is signal 18?

Signals

SIGSTKFLT	16	Stack fault
SIGCHLD	17	Child process has stopped or exited, changed (POSIX)
SIGCONT	18	Continue executing, if stopped (POSIX)
SIGSTOP	19	Stop executing(can't be caught or ignored) (POSIX)
SIGTSTP	20	Terminal stop signal (POSIX) ***Ctrl-Z or Ctrl-F***
SIGTTIN	21	Background process trying to read, from TTY (POSIX)
SIGTTOU	22	Background process trying to write, to TTY (POSIX)
SIGURG	23	Urgent condition on socket (4.2 BSD)
SIGXCPU	24	CPU limit exceeded (4.2 BSD)
SIGXFSZ	25	File size limit exceeded (4.2 BSD)
SIGVTALRM	26	Virtual alarm clock (4.2 BSD)
SIGPROF	27	Profiling alarm clock (4.2 BSD)
SIGWINCH	28	Window size change (4.3 BSD, Sun)
SIGIO	29	I/O now possible (4.2 BSD)
SIGPWR	30	Power failure restart (System V)

Signal 18 continues a stopped process … isn't that what bg does?

The bg command is used to resume a stopped process

```
/home/cis90/roddyduk $ sleep 60
Ctrl-F (or Ctrl-Z) typed here
[1]+  Stopped                 sleep 60
/home/cis90/roddyduk $ bg
[1]+ sleep 60 &
/home/cis90/roddyduk $ jobs
[1]+  Running                 sleep 60 &
/home/cis90/roddyduk $ jobs
[1]+  Running                 sleep 60 &
/home/cis90/roddyduk $ jobs
[1]+  Done                    sleep 60
/home/cis90/roddyduk $
```

bg resumed the stopped process which runs till it is finished

*Instead of using **bg** to resume a stopped process in the background, lets try a SIGCONT (signal 18) instead*

```
/home/cis90/roddyduk $ sleep 60
Ctrl-F (or Ctrl-Z) typed here
[1]+  Stopped                 sleep 60
/home/cis90/roddyduk $ ps -l
F S   UID   PID  PPID  C PRI  NI ADDR SZ WCHAN  TTY          TIME CMD
0 S  1000 10705 10704  0  76   0 -  1165 wait   pts/0    00:00:00 bash
0 T  1000 10743 10705  0  75   0 -   926 finish pts/0    00:00:00 sleep
0 R  1000 10744 10705  0  78   0 -  1051 -      pts/0    00:00:00 ps
/home/cis90/roddyduk $ jobs
[1]+  Stopped                 sleep 60
/home/cis90/roddyduk $ kill -18 10743
/home/cis90/roddyduk $ jobs
[1]+  Running                 sleep 60 &
/home/cis90/roddyduk $ ps -l
F S   UID   PID  PPID  C PRI  NI ADDR SZ WCHAN  TTY          TIME CMD
0 S  1000 10705 10704  0  75   0 -  1165 wait   pts/0    00:00:00 bash
0 S  1000 10743 10705  0  85   0 -   926 322800 pts/0    00:00:00 sleep
0 R  1000 10746 10705  0  77   0 -  1050 -      pts/0    00:00:00 ps
/home/cis90/roddyduk $ jobs
[1]+  Running                 sleep 60 &
/home/cis90/roddyduk $ jobs
[1]+  Running                 sleep 60 &
/home/cis90/roddyduk $ jobs
[1]+  Done                    sleep 60
```

Note sending a 18 signal or using the bg command will resume a stopped process

Signals

- Run and suspend two jobs
  - sleep 60
  - Ctrl-F (or Ctrl-Z)
  - sleep 90
  - Ctrl-F (or Ctrl-Z)
- Use **jobs** to see them
- Use **ps –lf** to get their PIDs
- Resume one job with the **bg** command
- Resume the other job with the kill -18 signal
- Use **jobs** to see if they complete

Review of Job Control

Job Control
A feature of the bash shell

&

Append to a command to run it in the background

bg

Resumes a suspended job in the background

fg

Brings the most recent background process to the foreground

jobs

Lists all background jobs

```
/home/cis90/roddyduk $ sleep 60
Ctrl-F typed here
[1]+  Stopped                 sleep 60
/home/cis90/roddyduk $ bg
[1]+ sleep 60 &
/home/cis90/roddyduk $ bg
-bash: bg: job 1 already in background
/home/cis90/roddyduk $ jobs
[1]+  Running                 sleep 60 &
/home/cis90/roddyduk $ sleep 90
Ctrl-F typed here
[2]+  Stopped                 sleep 90
/home/cis90/roddyduk $ sleep 120
Ctrl-F typed here
[3]+  Stopped                 sleep 120
/home/cis90/roddyduk $ jobs
[1]   Running                 sleep 60 &
[2]-  Stopped                 sleep 90
[3]+  Stopped                 sleep 120
/home/cis90/roddyduk $ bg 3
[3]+ sleep 120 &
[1]   Done                    sleep 60
/home/cis90/roddyduk $ jobs
[2]+  Stopped                 sleep 90
[3]-  Running                 sleep 120 &
/home/cis90/roddyduk $ bg 2
[2]+ sleep 90 &
/home/cis90/roddyduk $ jobs
[2]-  Running                 sleep 90 &
[3]+  Running                 sleep 120 &
/home/cis90/roddyduk $ jobs
[2]-  Done                    sleep 90
[3]+  Done                    sleep 120
```

*Multiple background jobs and using an argument on the **bg** command to resume a specific job*

Job Control

- Run and suspend two jobs
  sleep 75
  Ctrl-F or Ctrl-Z
  sleep 85
  Ctrl-F or Ctrl-Z
- Use **jobs** to see them
- Resume one job with the **bg** command
- Use **jobs** to see change
- Bring the other to the foreground with **fg**
- Use **jobs** when control returns to see that every process finished
- Use **sleep 15 &** to run in the background
- Use **jobs** to check on progress

The **mystery** of Ctrl-Z vs Ctrl-F

Signals
Special keystrokes

```
/home/cis90/roddyduk $ stty -a
speed 38400 baud; rows 26; columns 78; line = 0;
intr = ^C; quit = ^\; erase = ^?; kill = ^U; eof = ^D; eol = <undef>;
eol2 = <undef>; swtch = <undef>; start = ^Q; stop = ^S; susp = ^F; rprnt = ^R;
werase = ^W; lnext = ^V; flush = ^O; min = 1; time = 0;
```

```
[rsimms@opus ~]$ stty -a
speed 38400 baud; rows 39; columns 84; line = 0;
intr = ^C; quit = ^\; erase = ^?; kill = ^U; eof = ^D; eol = <undef>; eol2 = <undef>;
swtch = <undef>; start = ^Q; stop = ^S; susp = ^Z; rprnt = ^R; werase = ^W;
lnext = ^V; flush = ^O; min = 1; time = 0;
```

Why does the keystroke to send a Suspend (SIGTSTP or 20) signal differ between roddyduk (^F or Ctrl-F) and rsimms (^Z or Ctrl-Z)?

Signals

SIGSTKFLT	16	Stack fault
SIGCHLD	17	Child process has stopped or exited, changed (POSIX)
SIGCONT	18	Continue executing, if stopped (POSIX)
SIGSTOP	19	Stop executing(can't be caught or ignored) (POSIX)
SIGTSTP	20	Terminal stop signal (POSIX) ***Ctrl-Z or Ctrl-F***
SIGTTIN	21	Background process trying to read, from TTY (POSIX)
SIGTTOU	22	Background process trying to write, to TTY (POSIX)
SIGURG	23	Urgent condition on socket (4.2 BSD)
SIGXCPU	24	CPU limit exceeded (4.2 BSD)
SIGXFSZ	25	File size limit exceeded (4.2 BSD)
SIGVTALRM	26	Virtual alarm clock (4.2 BSD)
SIGPROF	27	Profiling alarm clock (4.2 BSD)
SIGWINCH	28	Window size change (4.3 BSD, Sun)
SIGIO	29	I/O now possible (4.2 BSD)
SIGPWR	30	Power failure restart (System V)

Note Signal 20 is used to stop a process and moves it to the background

Job Control

A feature of the bash shell

Ctrl-Z or Ctrl-F (sends SIGTSTP 20 signal)

- Stops (suspends) a foreground process

```
[rsimms@opus ~]$ sleep 5

[1]+  Stopped                 sleep 5
```

Ctrl-Z is tapped which stops the sleep command

PID 7728 is stopped

```
[rsimms@opus ~]$ ps -l  -u rsimms
F S   UID   PID  PPID  C PRI  NI ADDR SZ WCHAN  TTY          TIME CMD
5 S   201  5368  5365  0  75   0 -  2460 -      ?        00:00:00 sshd
0 S   201  5369  5368  0  76   0 -  1165 wait   pts/0    00:00:00 bash
5 S   201  6203  6200  0  75   0 -  2491 -      ?        00:00:00 sshd
0 S   201  6204  6203  0  75   0 -  1165 -      pts/6    00:00:00 bash
0 T   201  7728  6204  0  75   0 -   926 finish pts/6    00:00:00 sleep
0 R   201  7730  5369  0  78   0 -  1062 -      pts/0    00:00:00 ps
[rsimms@opus ~]$
```

Job Control

A feature of the bash shell

bg command

- Resumes a suspended job in the background

```
[rsimms@opus ~]$ sleep 5

[1]+  Stopped                 sleep 5
[rsimms@opus ~]$ bg
[1]+ sleep 5 &
[rsimms@opus ~]$
```

bg resumes the sleep command

PID 7728 is gone

```
[rsimms@opus ~]$ ps -l  -u rsimms
F S   UID   PID  PPID  C PRI  NI ADDR SZ WCHAN  TTY          TIME CMD
5 S   201  5368  5365  0  75   0 -  2460 -      ?        00:00:00 sshd
0 S   201  5369  5368  0  76   0 -  1165 wait   pts/0    00:00:00 bash
5 S   201  6203  6200  0  75   0 -  2491 -      ?        00:00:00 sshd
0 S   201  6204  6203  0  75   0 -  1165 -      pts/6    00:00:00 bash
0 R   201  7742  5369  0  78   0 -  1061 -      pts/0    00:00:00 ps
[rsimms@opus ~]$
```

Signals
Jim's app script

rsimms@opus:/home/cis90/depot

```
#!/bin/sh
#
# app - script to demostrate use of signals
#
# Usage:  run app with no options or parameters
#
# Send signals to it with keystrokes or kill command
#
# Notes:
# stty -echo stop the display of characters typed
# stty echo makes typed characters visible again
# stty susp ^Z sets suspend keystroke to Ctlr-Z (to stop forground processes)
# stty susp @ sets suspend character to @ (to stop foreground processes)
#
trap '' 2  #Ignore SIGINT
trap 'echo -n quit it!' 3 #Handle SIGQUIT
trap 'stty echo susp ^Z;echo ee; echo cleanup;exit' 15 #Handle SIGTERM
clear
banner testing
stty -echo susp @
sleep 1
echo  one
sleep 1
echo two
sleep 1
echo -n thr
while :
do sleep 1
done
~
                                                          13,1          All
```

This is why Cntl-F (suspend) stopped working and we had to use Ctrl-Z

Review of kill command usage

Jim's app script

Signal 2's (Ctrl-C) are ignored

rsimms@opus:/home/cis90/depot

```
#!/bin/sh
#
# app - script to demostrate use of signals
#
# Usage:  run app with no options or parameters
#
# Send signals to it with keystrokes or kill command
#
# Notes:
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# stty susp @ sets suspend character to @ (to stop foreground processes)
#
trap '' 2  #Ignore SIGINT
trap 'echo -n quit it!' 3 #Handle SIGQUIT
trap 'stty echo susp ^Z;echo ee; echo cleanup;exit' 15 #Handle SIGTERM
clear
banner testing
stty -echo susp @
sleep 1
echo  one
sleep 1
echo two
sleep 1
echo -n thr
while :
do sleep 1
done
~
                                                              13,1          46 All
```

Jim's app script

Signal 3's (Cntrl-\) print message

rsimms@opus:/home/cis90/depot

```
#!/bin/sh
#
# app - script to demostrate use of signals
#
# Usage:  run app with no options or parameters
#
# Send signals to it with keystrokes or kill command
#
# Notes:
# stty -echo stop the display of characters typed
# stty echo makes typed characters visible again
# stty susp ^Z sets suspend keystroke to Ctlr-Z (to stop forground processes)
# stty susp @ sets suspend character to @ (to stop foreground processes)
#
trap '' 2  #Ignore SIGINT
trap 'echo -n quit it!' 3 #Handle SIGQUIT
trap 'stty echo susp ^Z;echo ee; echo cleanup;exit' 15 #Handle SIGTERM
clear
banner testing
stty -echo susp @
sleep 1
echo  one
sleep 1
echo two
sleep 1
echo -n thr
while :
do sleep 1
done
~
                                                          13,1          47 All
```

Jim's app script

Signal 15's close gracefully

rsimms@opus:/home/cis90/depot

```
#!/bin/sh
#
# app - script to demostrate use of signals
#
# Usage:  run app with no options or parameters
#
# Send signals to it with keystrokes or kill command
#
# Notes:
# stty -echo stop the display of characters typed
# stty echo makes typed characters visible again
# stty susp ^Z sets suspend keystroke to Ctlr-Z (to stop forground processes)
# stty susp @ sets suspend character to @ (to stop foreground processes)
#
trap '' 2  #Ignore SIGINT
trap 'echo -n quit it!' 3 #Handle SIGQUIT
trap 'stty echo susp ^Z;echo ee; echo cleanup;exit' 15 #Handle SIGTERM
clear
banner testing
stty -echo susp @
sleep 1
echo  one
sleep 1
echo two
sleep 1
echo -n thr
while :
do sleep 1
done
~
                                                              13,1          48 All
```

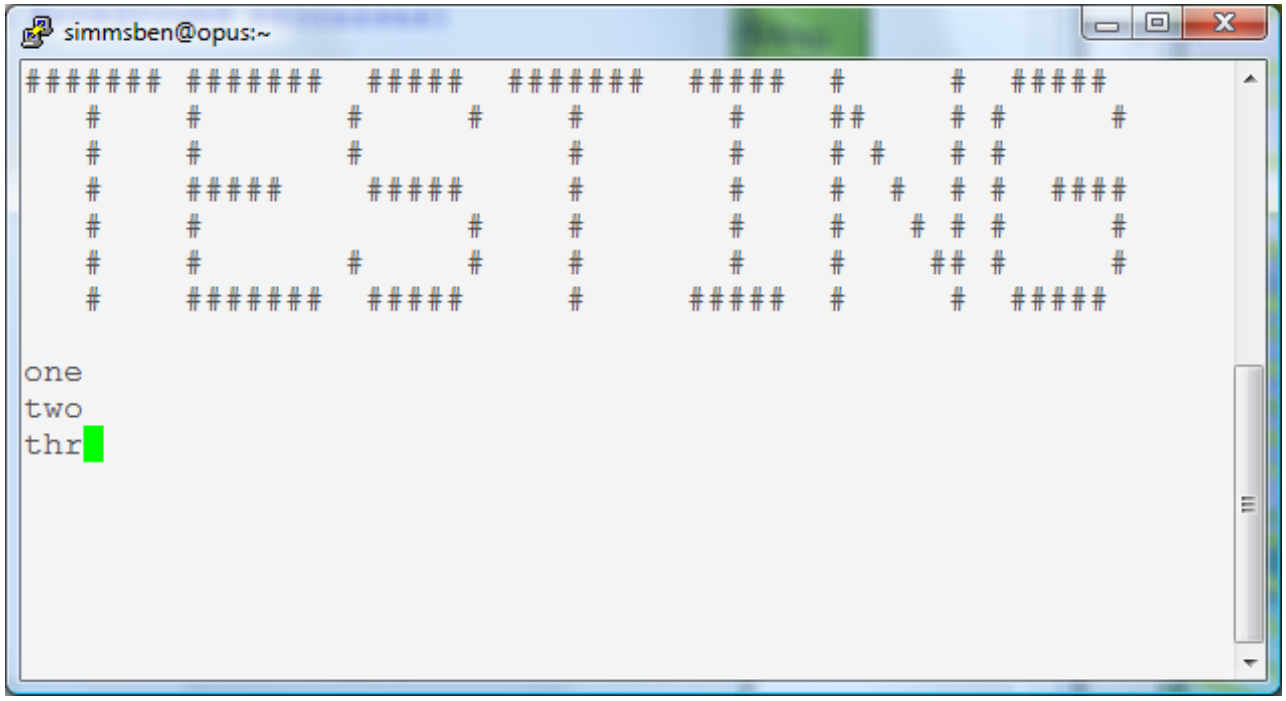
Jim's app script

Endless loop

rsimms@opus:/home/cis90/depot

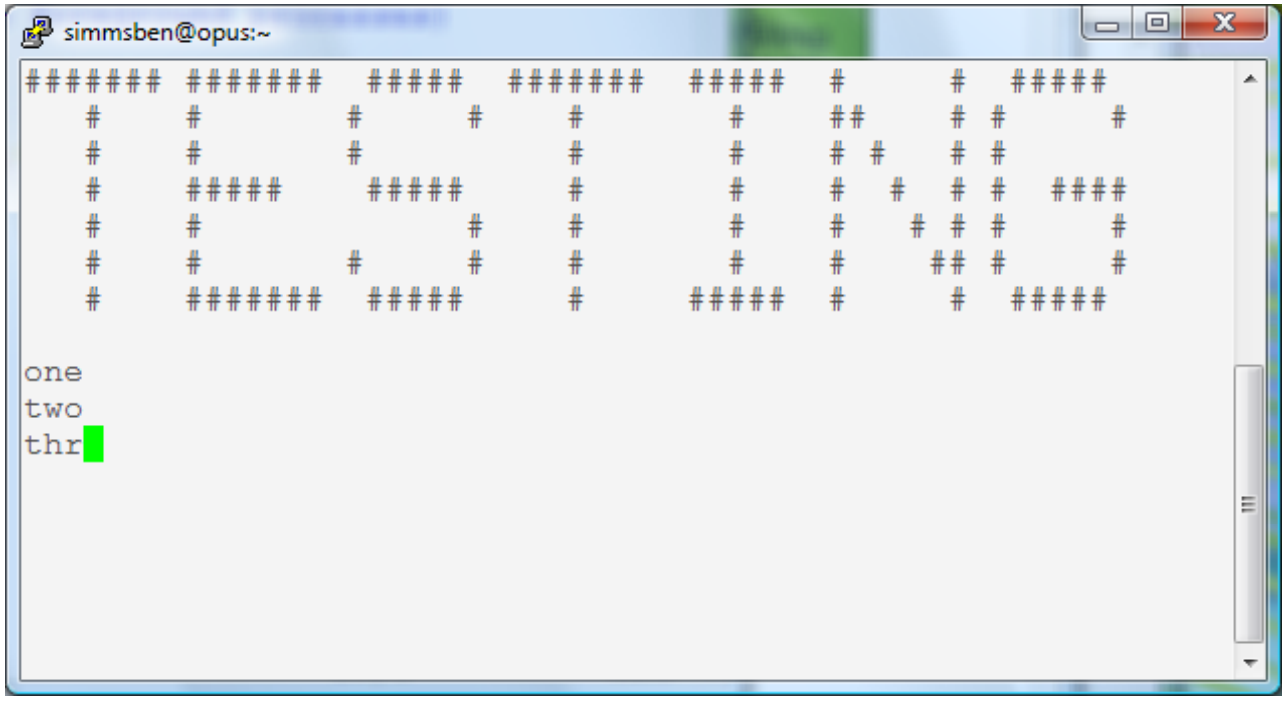
```
#!/bin/sh
#
# app - script to demostrate use of signals
#
# Usage:  run app with no options or parameters
#
# Send signals to it with keystrokes or kill command
#
# Notes:
# stty -echo stop the display of characters typed
# stty echo makes typed characters visible again
# stty susp ^Z sets suspend keystroke to Ctlr-Z (to stop forground processes)
# stty susp @ sets suspend character to @ (to stop foreground processes)
#
trap '' 2  #Ignore SIGINT
trap 'echo -n quit it!' 3 #Handle SIGQUIT
trap 'stty echo susp ^Z;echo ee; echo cleanup;exit' 15 #Handle SIGTERM
clear
banner testing
stty -echo susp @
sleep 1
echo  one
sleep 1
echo two
sleep 1
echo -n thr
while :
do sleep 1
done
~
                                                    13,1          49 All
```

Signals
Benji runs app



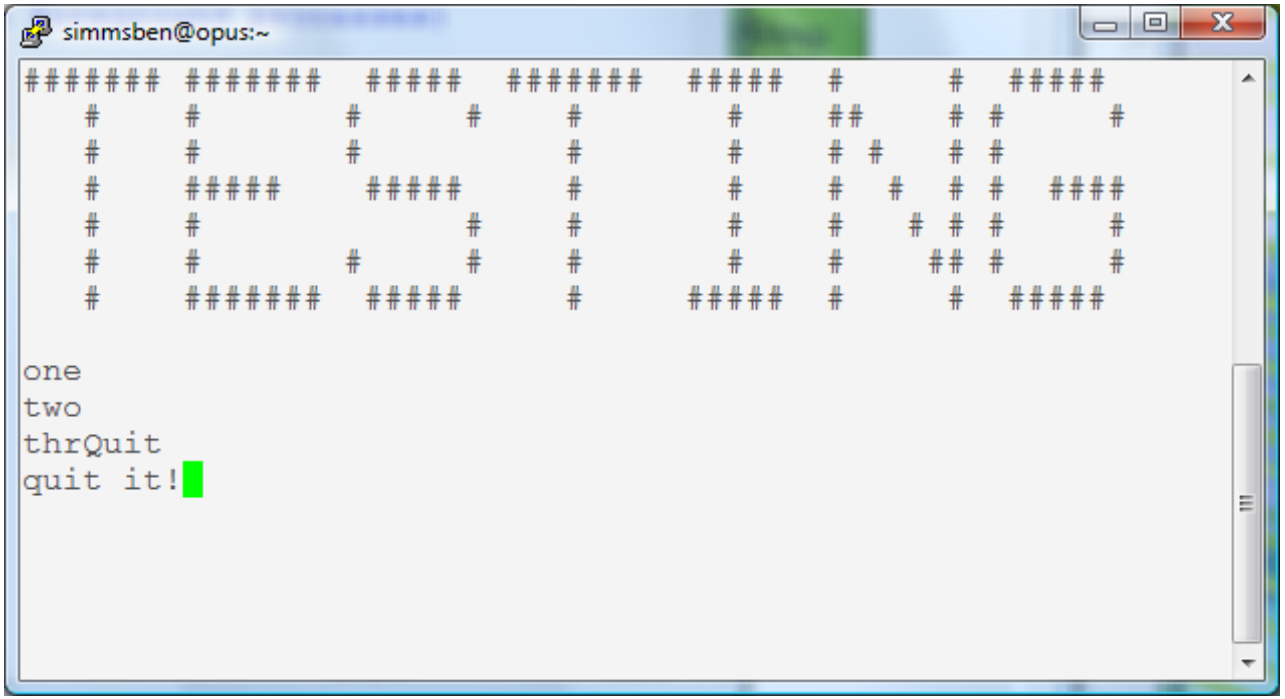
Benji logs in and runs app … uh oh, its stuck !

Signals
Benji runs app



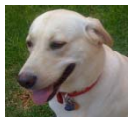
Benji tries using the keyboard to send a SIGINT using Ctrl-C but nothing happens (because app is ignoring SIGINT)

Signals
Benji runs app



Benji tries using the keyboard to send a SIGQUIT using Ctrl-\ but app reacts by saying "quit it"

Signals
Benji runs app



```
roddyduk@opus:~
/home/cis90/roddyduk $ ps -u simmsben
  PID TTY          TIME CMD
 6657 ?        00:00:00 sshd
 6658 pts/1    00:00:00 bash
 7033 ?        00:00:00 sshd
 7034 pts/2    00:00:00 bash
 7065 pts/2    00:00:00 app
 7579 pts/2    00:00:00 sleep
/home/cis90/roddyduk $ kill 7065
-bash: kill: (7065) - Operation not permitted
/home/cis90/roddyduk $
```

Benji asks his friend Duke to kill off his stalled app process. Duke uses ps to look it up but does not have permission to kill it off

Signals

Benji runs app

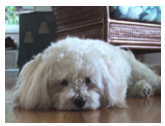
simmsben@opus:~

```
#######  #######   #####   #######   #####   #       #   #####
   #     #         #     #    #        #     ##     # #      #
   #     #         #          #        #     # #    # #
   #     #####     #####      #        #     #  #   # #   ####
   #     #               #    #        #     #    # # #      #
   #     #         #     #    #        #     #     ## #      #
   #     #######   #####     #        #####  #      #  #####
```

```
one
two
thrQuit
quit it!
```

simmsben@opus:~

```
/home/cis90/simmsben $ ps -u simmsben
  PID TTY          TIME CMD
 6657 ?        00:00:00 sshd
 6658 pts/1    00:00:00 bash
 7033 ?        00:00:00 sshd
 7034 pts/2    00:00:00 bash
 7065 pts/2    00:00:00 app
 7843 pts/2    00:00:00 sleep
 7844 pts/1    00:00:00 ps
/home/cis90/simmsben $ kill -2 7065
/home/cis90/simmsben $
```



Benji logs into another Putty session and sends a SIGINT using the kill command .... but nothing happens

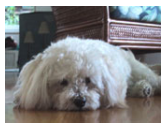
Signals

Benji runs app

simmsben@opus:~

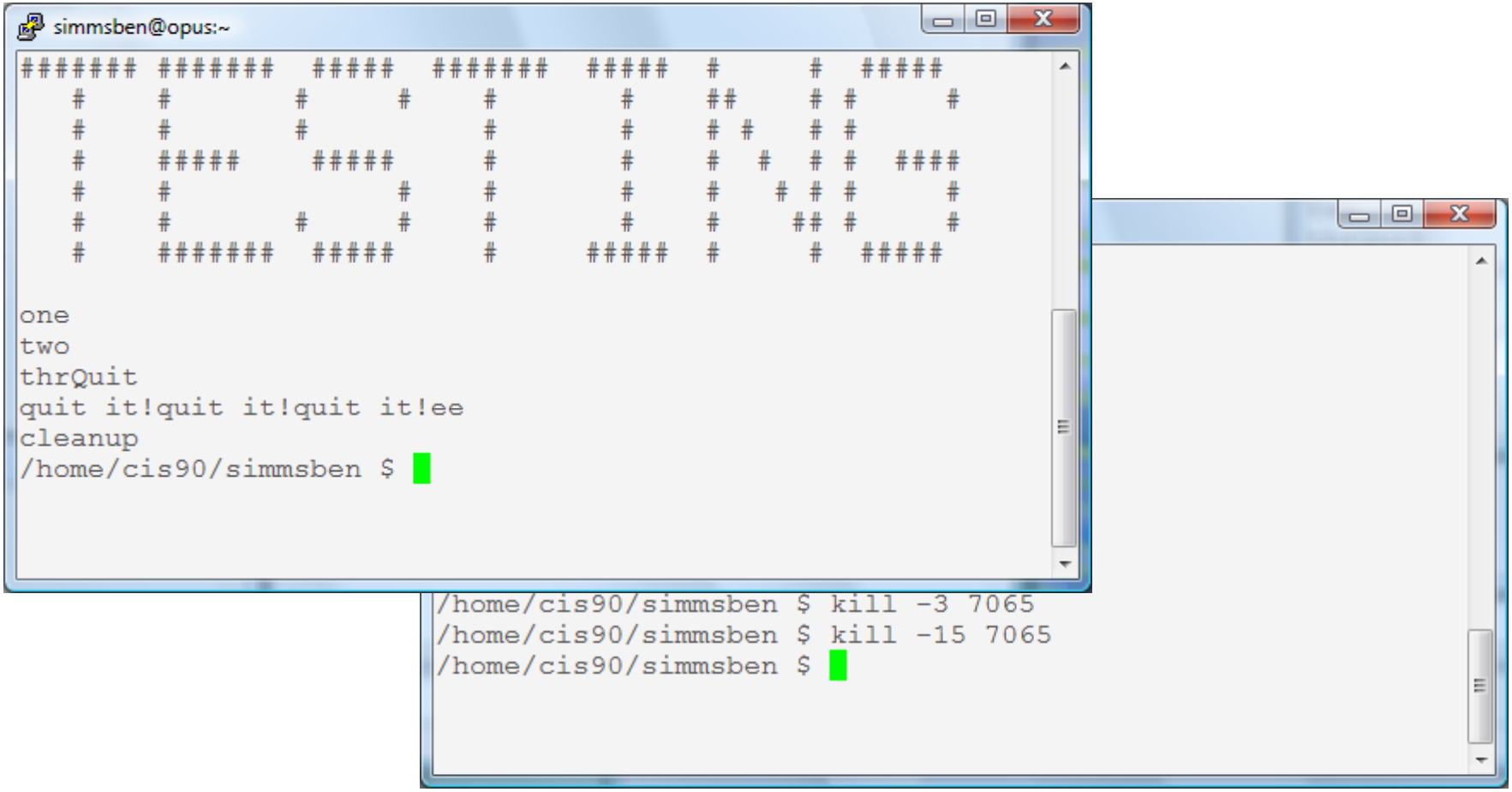
```
one
two
thrQuit
quit it!quit it!quit it!
```

```
/home/cis90/simmsben $ kill -3 7065
/home/cis90/simmsben $ kill -3 7065
/home/cis90/simmsben $
```



Benji ups the ante and sends two SIGQUITs but the app process shrugs them off with two "quit it!" messages

Signals
Benji runs app



Benji decides to send a SIGTERM this time and the app process finishes, cleans up and exits

Signals
Benji runs app

simmsben@opus:~

```
one
two
thr
```

simmsben@opus:~

```
/home/cis90/simmsben $ ps -u simmsben
  PID TTY          TIME CMD
 6657 ?        00:00:00 sshd
 6658 pts/1    00:00:00 bash
 7033 ?        00:00:00 sshd
 7034 pts/2    00:00:00 bash
 8237 pts/2    00:00:00 app
 8279 pts/2    00:00:00 sleep
 8280 pts/1    00:00:00 ps
/home/cis90/simmsben $
```

The same thing happens again another day. This time Benji does not care what happens with app ...

Signals

Benji runs app

simmsben@opus:~

```
one
two
thrKilled
/home/cis90/simmsben $
```

simmsben@opus:~

```
/home/cis90/simmsben $ ps -u simmsben
  PID TTY          TIME CMD
 6657 ?        00:00:00 sshd
 6658 pts/1    00:00:00 bash
 7033 ?        00:00:00 sshd
 7034 pts/2    00:00:00 bash
 8237 pts/2    00:00:00 app
 8279 pts/2    00:00:00 sleep
 8280 pts/1    00:00:00 ps
/home/cis90/simmsben $ kill -9 8237
/home/cis90/simmsben $
```

So he sends a SIGKILL this time … and app never even sees it coming …. poof … app is gone

Review of Load Balancing

Load Balancing

The **at** command reads from stdin or a file for a list of commands to run, and begins running them at the time of day specified as the first argument:

```
$ at 10:30pm < batch_file
```

```
$ at 11:59pm
at> cat files.out bigshell > lab08
at> cp lab08 /home/rsimms/cis90/$LOGNAME
at> Ctrl-D
$
```

Note: Use Ctrl-D must be entered as the first character on the last line.

Note: This is how you actually submit Lab 8

Load Balancing

This job makes a backup of myscript and sends an email when finished

```
/home/cis90/roddyduk $ cat job1
cp bin/myscript bin/myscript.bak
echo "Job 1 - finished, myscript has been backed up" | mail -s "Job 1" roddyduk
/home/cis90/roddyduk $ at now + 5 minutes < job1
job 24 at 2008-11-12 12:14
/home/cis90/roddyduk $ at now + 2 hours < job1
job 25 at 2008-11-12 14:09
/home/cis90/roddyduk $ at teatime < job1
job 26 at 2008-11-12 16:00
/home/cis90/roddyduk $ at now + 1 week < job1
job 27 at 2008-11-19 12:10
/home/cis90/roddyduk $ at 3:00 12/12/2008 < job1
job 28 at 2008-12-12 03:00
/home/cis90/roddyduk $ jobs
/home/cis90/roddyduk $ atq
25      2008-11-12 14:09 a roddyduk
28      2008-12-12 03:00 a roddyduk
27      2008-11-19 12:10 a roddyduk
26      2008-11-12 16:00 a roddyduk
24      2008-11-12 12:14 a roddyduk
/home/cis90/roddyduk $
```

Several ways to specify a future time to run

*Use the **atq** command to show queued jobs*

Load Balancing

```
/home/cis90/roddyduk $ jobs
/home/cis90/roddyduk $ atq
25      2008-11-12 14:09 a roddyduk
28      2008-12-12 03:00 a roddyduk
27      2008-11-19 12:10 a roddyduk
26      2008-11-12 16:00 a roddyduk
24      2008-11-12 12:14 a roddyduk
/home/cis90/roddyduk $ atrm 24
/home/cis90/roddyduk $ atq
25      2008-11-12 14:09 a roddyduk
28      2008-12-12 03:00 a roddyduk
27      2008-11-19 12:10 a roddyduk
26      2008-11-12 16:00 a roddyduk
/home/cis90/roddyduk $
```

*The **jobs** command lists processes running or suspended in the background.*

*The **atq** command lists jobs queued to run in the futures that were scheduled by at command*

*The **atrm** command is used to remove jobs from the queue*

vi

vi practice

- Bring up the vi reference page at:
  http://simms-teach.com/docs/vi-ref.html
- Create a directory called *practice*
  mkdir practice
- Copy in sample text files
  cp /rsimms/cis90/depot/* practice

vi

Moving around in a file

Note: to execute any of the following commands from vi, you must be in command mode. Press the Esc key to enter command mode.

h moves the cursor one character to the left
j moves the cursor down one line
k moves the cursor up one line
l moves the cursor one character to the right
w moves the cursor one "word" forward
b moves the cursor one "word" back
0 (zero) moves the cursor to the beginning of the line
$ moves the cursor to the end of the line
G moves the cursor to the last line in the file
1G moves the cursor to the first line in the file
105G moves the cursor to line 105
^d scrolls down 10 lines
^u scrolls up 10 lines
^f page forward one page
^b page back one page

Try typing a number in front of these commands and notice what happens

vi

Practice using these commands

Note: to execute any of the following commands from vi, you must be in command mode. Press the Esc key to enter command mode.

h moves the cursor one character to the left
j moves the cursor down one line
k moves the cursor up one line
l moves the cursor one character to the right
w moves the cursor one "word" forward
b moves the cursor one "word" back
0 (zero) moves the cursor to the beginning of the line
$ moves the cursor to the end of the line
G moves the cursor to the last line in the file
1G moves the cursor to the first line in the file
105G moves the cursor to line 105
^d scrolls down 10 lines
^u scrolls up 10 lines
^f page forward one page
^b page back one page

Try typing a number in front of these commands and notice what happens

vi

Reading and Writing out files

Note: to execute any of the following commands from vi, you must be in command mode. Press the Esc key to enter command mode.

:q exits vi if you have saved your changes
:q! exits vi even if you have not saved your changes
:w saves any changes you've made to the file you are editing
:w *filename* saves your file to a new name (like Save As)
:w! *filename* saves your file to a new name overwriting any previous data
:r *filename* reads in the contents of *filename* starting from the cursor position
:e *filename* replaces the current content with the content from *filename*

vi

Now practice these commands

Note: to execute any of the following commands from vi, you must be in command mode. Press the Esc key to enter command mode.

:q exits vi if you have saved your changes
:q! exits vi even if you have not saved your changes
:w saves any changes you've made to the file you are editing
:w *filename* saves your file to a new name (like Save As)
:w! *filename* saves your file to a new name overwriting any previous data
:r *filename* reads in the contents of *filename* starting from the cursor position
:e *filename* replaces the current content with the content from *filename*

vi

Entering Input mode

i Ready to insert characters immediately before the current cursor position
a Ready to append characters immediately after the current cursor position
I Ready to insert characters at the start of the current line
A Ready to append characters at the end of the current line
o Ready to input characters in a new line that opens up below the cursor
O Ready to input characters in a new line that opens up above the cursor
r Ready to replace the current character with the character you type next
R Ready to Replace (overwrite) characters starting at the curent cursor position
s Ready to replace the current character with the string you type next
cw Ready to replace the current word with the string you type next

vi

Now practice these commands

i Ready to insert characters immediately before the current cursor position
a Ready to append characters immediately after the current cursor position
I Ready to insert characters at the start of the current line
A Ready to append characters at the end of the current line
o Ready to input characters in a new line that opens up below the cursor
O Ready to input characters in a new line that opens up above the cursor
r Ready to replace the current character with the character you type next
R Ready to Replace (overwrite) characters starting at the curent cursor position
s Ready to replace the current character with the string you type next
cw Ready to replace the current word with the string you type next

vi

Cut, Copy, Pasting Commands

Note: to execute any of the following commands from vi, you must be in command mode. Press the Esc key to enter command mode.

x Deletes the current character
dw Deletes the current word
dd Deletes the current line
D Deletes to the end of the line
yy Copies a line to the clipboard buffer
p Pastes whatever is in the clipboard buffer below the current cursor
P Pastes whatever is in the clipboard buffer above the current cursor

vi

Now practice these commands

Note: to execute any of the following commands from vi, you must be in command mode. Press the Esc key to enter command mode.

x Deletes the current character
dw Deletes the current word
dd Deletes the current line
D Deletes to the end of the line
yy Copies a line to the clipboard buffer
p Pastes whatever is in the clipboard buffer below the current cursor
P Pastes whatever is in the clipboard buffer above the current cursor

vi

Miscellaneous Useful Commands

Note: to execute any of the following commands from vi, you must be in command mode. Press the Esc key to enter command mode.

^g Tells you the filename you are editing and what line your cursor is on
u Undoes the last command you executed
. Repeats the last command you executed
/string Searches for the string of characters in the file
n Finds the next occurrence of the current search string looking down the file
N Finds the next occurrence of the current search string looking up the file
~ Changes the case of the current character

vi

Now practice these commands

Note: to execute any of the following commands from vi, you must be in command mode. Press the Esc key to enter command mode.

^g Tells you the filename you are editing and what line your cursor is on
u Undoes the last command you executed
. Repeats the last command you executed
/string Searches for the string of characters in the file
n Finds the next occurrence of the current search string looking down the file
N Finds the next occurrence of the current search string looking up the file
~ Changes the case of the current character

vi

Making a script

In your bin directory, create a file called color and add the following lines:

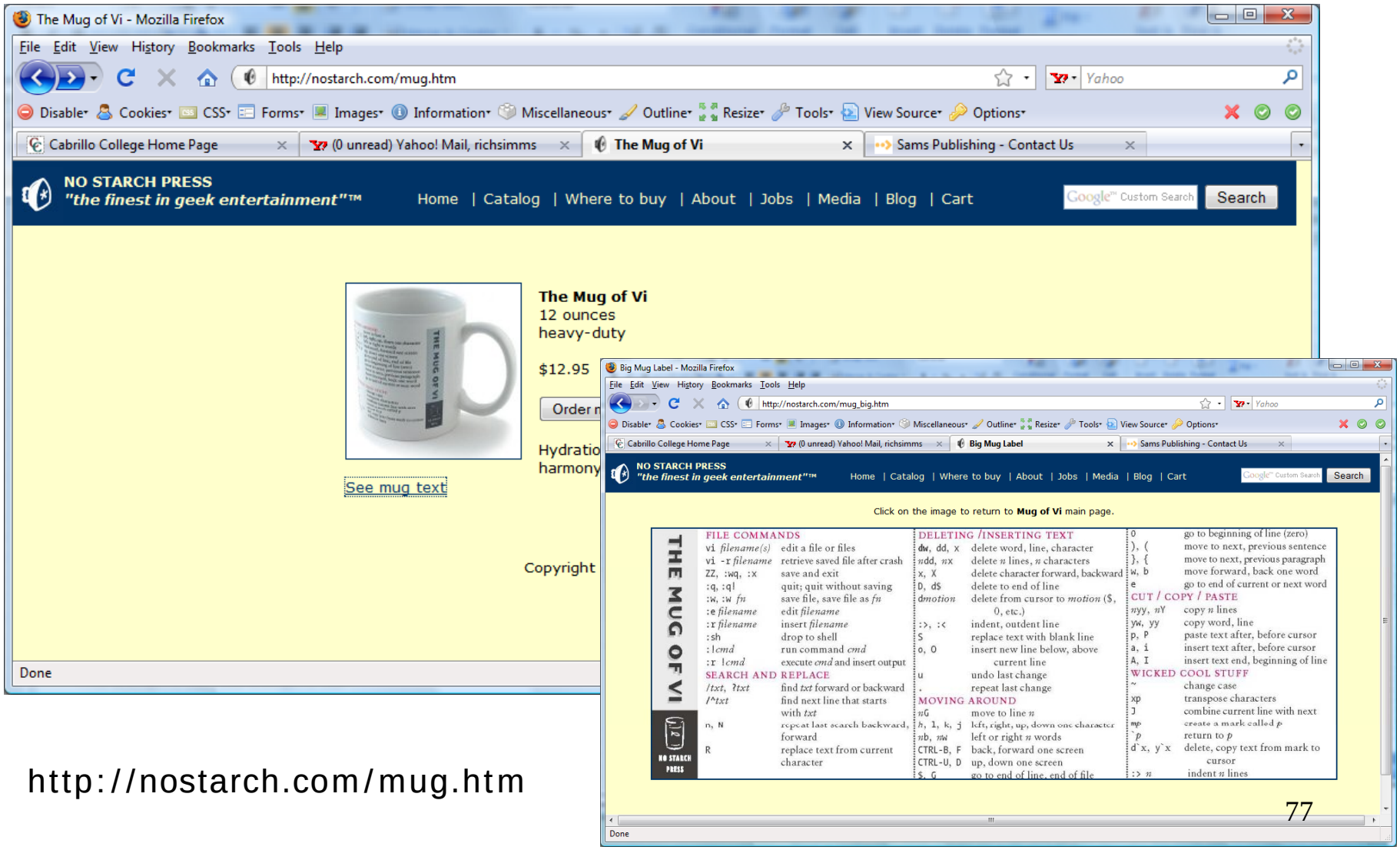
```
echo -n "What is your name? "
read NAME
echo -n "What is your favorite color? "
read COLOR
echo "Hi $NAME, your favorite color is $COLOR"
```

*Save the file, and give it execute permissions with **chmod +x color***

Now run your script by typing its name

http://vim.wikia.com/wiki/Main_Page

The Mug of vi



http://nostarch.com/mug.htm

/bin/mail and vi

```
/home/cis90/simmsben $ mail roddyduk
Subject: Good bones
Hey Duke,
I really appreciate thatbone you sent me last week.
Let me knwo if you want to go mark some fench posts
this weekend.
Later,
Ben
```

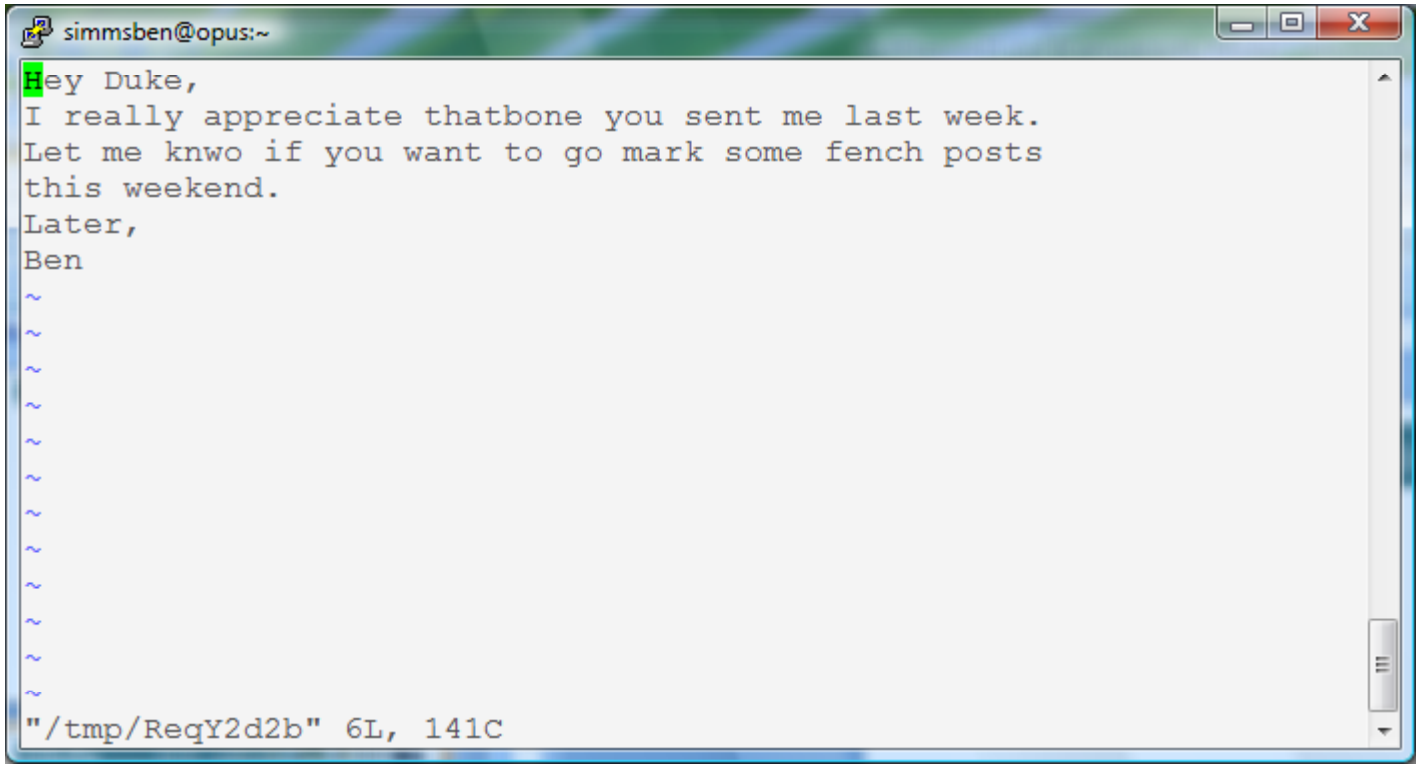
You are composing a message and you spot some typos …
CRUD … what can you do?

/bin/mail and vi

```
/home/cis90/simmsben $ mail roddyduk
Subject: Good bones
Hey Duke,
I really appreciate thatbone you sent me last week.
Let me knwo if you want to go mark some fench posts
this weekend.
Later,
Ben
~v
```

Well ... you could try the ~v command

/bin/mail and vi



The message is loaded into vi where changes or additions can be made. :wq is used to save and quit vi

/bin/mail and vi

```
/home/cis90/simmsben $ mail roddyduk
Subject: Good bones
Hey Duke,
I really appreciate thatbone you sent me last week.
Let me knwo if you want to go mark some fench posts
this weekend.
Later,
Ben
~v
(continue)
.
Cc:
/home/cis90/simmsben $
```

The earlier text with typos is still showing, however the corrected version is what is actually sent.

/bin/mail and vi

```
/home/cis90/roddyduk $ mail
Mail version 8.1 6/6/93.  Type ? for help.
"/var/spool/mail/roddyduk": 1 message 1 unread
>U  1 simmsben@opus.cabril  Mon Nov 10 20:25  22/782   "Good bones"
& 1
Message 1:
From simmsben@opus.cabrillo.edu  Mon Nov 10 20:25:32 2008
Date: Mon, 10 Nov 2008 20:25:32 -0800
From: Benji Simms <simmsben@opus.cabrillo.edu>
To: roddyduk@opus.cabrillo.edu
Subject: Good bones

Hey Duke,
I really appreciate that bone you sent me last week.
Let me know if you want to go mark some fence posts
this weekend.
Later,
Ben

&
```

The message Duke reads has all the typos fixed.

A Tangent on Spell

spell command

```
/home/cis90/roddyduk/edits $ cat text
Welcome to the CIS 90 class !!

/home/cis90/roddyduk/edits $ spell text
CIS
```

spell *command flags CIS as misspelled word.*

How can we add CIS to the dictionary?

spell command

```
/home/cis90/roddyduk/edits $ cat text
Welcome to the CIS 90 class !!
/home/cis90/roddyduk/edits $ spell text
CIS
```

How can we add CIS to the dictionary?

```
/home/cis90/roddyduk/edits $ man spell
No manual entry for spell
/home/cis90/roddyduk/edits $ type spell
spell is hashed (/usr/bin/spell)
/home/cis90/roddyduk/edits $ file /usr/bin/spell
/usr/bin/spell: Bourne shell script text executable
/home/cis90/roddyduk/edits $ cat /usr/bin/spell
#!/bin/sh

# aspell list mimicks the standard unix spell program, roughly.

cat "$@" | aspell list --mode=none | sort -u

/home/cis90/roddyduk/edits $
```

Hmmm. No man page for spell ???????????

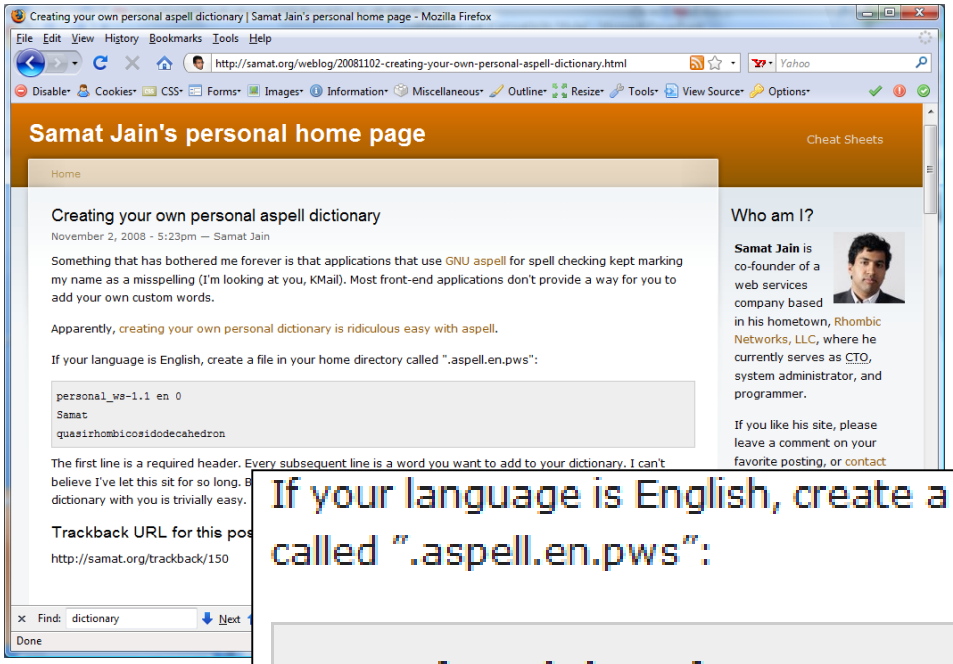
*OK, the actual command is **aspell***

spell command

```
ASPELL(1)                Aspell Abbreviated User's Manual                ASPELL(1)

NAME
       aspell - interactive spell checker

SYNOPSIS
       aspell [options] <command>

DESCRIPTION
       aspell  is  a utility that can function as an ispell -a replacement,
       as an independent spell checker, as  a  test  utility  to  test  out
       Aspell features, and as a utility for managing dictionaries.

COMMANDS
       <command> is one of:

       -?,help
              display the help message

       -c,check file
              to spell-check a file
```

There must be a way to add CIS …. but … lets try google

spell command



How to add words to your dictionary

If your language is English, create a file in your home directory called ".aspell.en.pws":

```
personal_ws-1.1 en 0
Samat
quasirhombicosidodecahedron
```

Googling "linux aspell personal dictionary" yields this page

Bingo! Thank you Samat Jain

spell command

```
/home/cis90/roddyduk/edits $ cd
/home/cis90/roddyduk $ echo "personal_ws-1.1 en 0" >  .aspell.en.pws
/home/cis90/roddyduk $ echo "CIS" >> .aspell.en.pws
/home/cis90/roddyduk $ cd edits/
/home/cis90/roddyduk/edits $ spell text
/home/cis90/roddyduk/edits $
```

This is how you would add your own custom dictionary to be used with spell checks

Wrap up

New commands:

vi	Run vi editor

New Files and Directories:

na	na

Next Class

Assignment: Check Calendar Page on web site to see what is due next week.

Lab 9
Five Posts

Quiz questions for next class:

- How do you send a SIGKILL to one of your own processes?

- What vi command is used to exit vi without saving any of the changes you made?

- What vi commands are used for copy and paste?

Backup

```
/home/cis90/roddyduk $ bash
[roddyduk@opus ~]$ bash
[roddyduk@opus ~]$ bash
[roddyduk@opus ~]$ ps
  PID TTY          TIME CMD
11198 pts/6    00:00:00 bash
11233 pts/6    00:00:00 bash
11257 pts/6    00:00:00 bash
11284 pts/6    00:00:00 bash
11309 pts/6    00:00:00 ps
[roddyduk@opus ~]$ ps -l
F S   UID   PID  PPID  C PRI  NI ADDR SZ WCHAN  TTY          TIME CMD
0 S  1000 11198 11197  0  75   0 -  1165 wait   pts/6    00:00:00 bash
0 S  1000 11233 11198  0  75   0 -  1166 wait   pts/6    00:00:00 bash
0 S  1000 11257 11233  0  75   0 -  1166 wait   pts/6    00:00:00 bash
0 S  1000 11284 11257  0  75   0 -  1165 wait   pts/6    00:00:00 bash
0 R  1000 11312 11284  0  77   0 -  1051 -      pts/6    00:00:00 ps
[roddyduk@opus ~]$ exit
exit
[roddyduk@opus ~]$ exit
exit
[roddyduk@opus ~]$ exit
exit
/home/cis90/roddyduk $ ps -l
F S   UID   PID  PPID  C PRI  NI ADDR SZ WCHAN  TTY          TIME CMD
0 S  1000 11198 11197  0  75   0 -  1165 wait   pts/6    00:00:00 bash
0 R  1000 11363 11198  0  77   0 -  1051 -      pts/6    00:00:00 ps
/home/cis90/roddyduk $
```

Parent and child

Resume stopped jobs with bg and kill -18

```
[roddyduk@opus ~]$ sleep 60

[1]+  Stopped                 sleep 60
[roddyduk@opus ~]$ sleep 90

[2]+  Stopped                 sleep 90
[roddyduk@opus ~]$ ps -lf
F S UID        PID  PPID  C PRI  NI ADDR SZ WCHAN  STIME TTY          TIME CMD
0 S roddyduk 11529 11528  0  75   0 -  1165 wait   09:36 pts/6    00:00:00 -bash
0 S roddyduk 11560 11529  0  75   0 -  1165 wait   09:36 pts/6    00:00:00 bash
0 S roddyduk 11584 11560  0  75   0 -  1166 wait   09:36 pts/6    00:00:00 bash
0 S roddyduk 11608 11584  0  75   0 -  1166 wait   09:36 pts/6    00:00:00 bash
0 T roddyduk 11796 11608  0  75   0 -   926 finish 09:49 pts/6    00:00:00 sleep
60
0 T roddyduk 11798 11608  0  75   0 -   926 finish 09:49 pts/6    00:00:00 sleep
90
0 R roddyduk 11803 11608  0  77   0 -  1062 -      09:49 pts/6    00:00:00 ps -lf
[roddyduk@opus ~]$ jobs
[1]-  Stopped                 sleep 60
[2]+  Stopped                 sleep 90
[roddyduk@opus ~]$ bg
[2]+ sleep 90 &
[roddyduk@opus ~]$ jobs
[1]+  Stopped                 sleep 60
[2]-  Running                 sleep 90 &
[roddyduk@opus ~]$ kill -18 11796
[roddyduk@opus ~]$ jobs
[1]-  Done                    sleep 60
[2]+  Running                 sleep 90 &
```

```
/home/cis90/roddyduk $ sleep 60
Ctrl-F typed here
[1]+  Stopped                 sleep 60
/home/cis90/roddyduk $ ps -l
F S   UID   PID  PPID  C PRI  NI ADDR SZ WCHAN  TTY          TIME CMD
0 S  1000 10705 10704  0  75   0 -  1165 wait   pts/0    00:00:00 bash
0 T  1000 10737 10705  0  84   0 -   927 finish pts/0    00:00:00 sleep
0 R  1000 10739 10705  0  77   0 -  1051 -      pts/0    00:00:00 ps
/home/cis90/roddyduk $ kill -18 10737
/home/cis90/roddyduk $ ps -l
F S   UID   PID  PPID  C PRI  NI ADDR SZ WCHAN  TTY          TIME CMD
0 S  1000 10705 10704  0  76   0 -  1165 wait   pts/0    00:00:00 bash
0 S  1000 10737 10705  0  78   0 -   927 322800 pts/0    00:00:00 sleep
0 R  1000 10741 10705  0  78   0 -  1051 -      pts/0    00:00:00 ps
/home/cis90/roddyduk $ jobs
[1]+  Done                    sleep 60
```

*Instead of using **bg** to resume a stopped process in the backgroud, lets use a kill signal instead*

Test Results

Test 2 Results

Incorrect answer pareto

13 xxxxxxxxxxxxxxxxxx (pipes)
28 xxxxxxxxxxxxxxxx (redirection)
19 xxxxxxxxxxxx (path)
18 xxxxxxxxxx (permissions)
20 xxxxxxxxxx (combo)
30 xxxxxxxxx (parsing)
21 xxxxxxxx (path)
29 xxxxxxxx (redirection)
12 xxxxxxxx (umask with cp)
27 xxxxxxxx (pipes)
23 xxxxxxx (chgrp)
24 xxxxxx (permissions)
22 xxxxx (mkdir)
07 xxxxx (permissions)
15 xxxxx (permissions)
14 xxxx (permissions)
26 xxxx (redirection)
05 xxxx (umask)
06 xxx (permission)
10 xxx (tee)
16 xx (permissions)
08 xx (links)
09 x (file descriptors)

Extra Credit

31 xxxxxxxxxxxxxxxxxxx (combo)
33 xxxxxxxxxxxxxx (parsing)
32 xxxxxxxxxxx (grep and piping)

Test 2 Q13

13. What complete command (with no ";"s) counts all the files belonging to you on the system, places a sorted list of them in the file *allmine*, and redirects error messages to the bit bucket?

Limits the files listed to just those owned by the user. The shell replaces $LOGNAME with the actual username.

The tee send the sorted files to both the file allmine and to the stdin of the wc command

```
find / -user $LOGNAME 2> /dev/null | sort | tee allmine | wc -l
```

find will list all files starting at / on the UNIX file tree

Permission errors are thrown away (from trying to list or traverse directories you don't have read and execute permission)

Use Opus to verify your answer

Test 2 Q28 answer

28. Given the file *problems* contains:

```
2+2
5/0
```

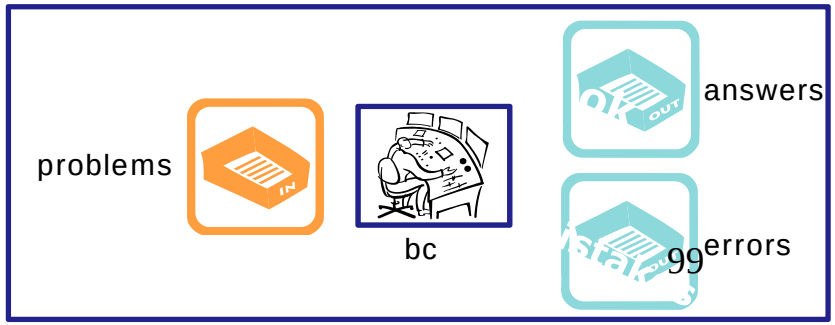
What complete command using bc would input the math problems in *problems*, append the calculated answers to the file *answers* and write any errors to the file *errors*?

stdin redirected from keyboard to file problems

stderr redirected from terminal to file errors

```
bc < problems >> answers 2> errors
```

stdout redirected from terminal to append to file answers



Test 2 Q28 verification

28. Given the file *problems* contains:

```
2+2
5/0
```

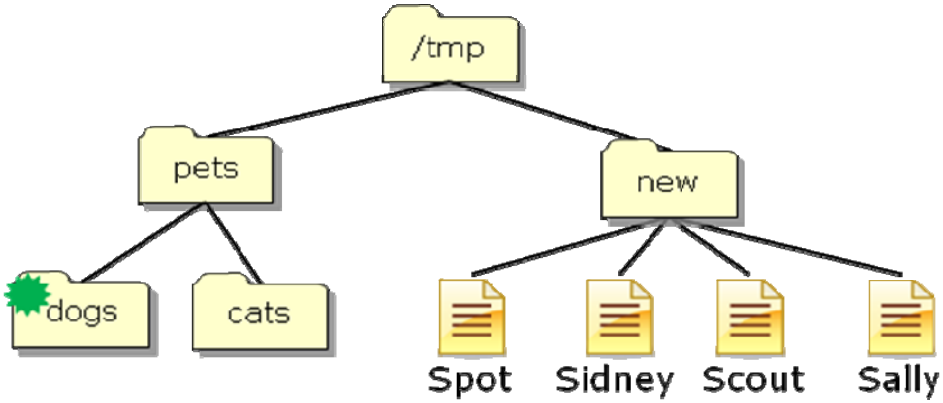
What complete command using bc would input the math problems in *problems*, append the calculated answers to the file *answers* and write any errors to the file *errors*?

```
/home/cis90/roddyduk $ echo 2+2 > problems
/home/cis90/roddyduk $ echo 5/0 >> problems
/home/cis90/roddyduk $ bc < problems >> answers 2> errors
/home/cis90/roddyduk $ cat answers errors
4
Runtime error (func=(main), adr=5): Divide by zero
/home/cis90/roddyduk $
```

To verify your answer on Opus, create the problems file the test your answer

Test 2 Q19 answer

19. Given this directory structure:



If your current working directory is *dogs*, what single command using filename expansion characters would move just the files *Scout* and *Sally* to the *dogs* directory?

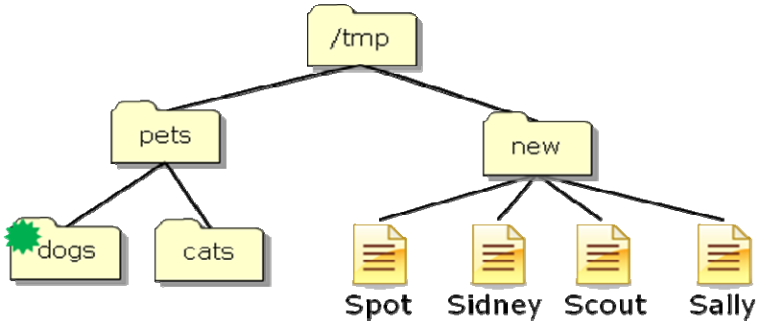
The shell replaces this with:
/tmp/new/Scout and /tmp/new/Sally

```
mv /tmp/new/S[ca]*  .
```

here

Test 2 Q19 verification

```
/home/cis90/roddyduk $ cd /tmp
/tmp $ mkdir -p pets pets/dogs pets/cats new
/tmp $ cd new; touch Spot Sidney Scout Sally; cd ..
/tmp $ ls -R pets new
new:
Sally  Scout  Sidney  Spot

pets:
cats  dogs

pets/cats:

pets/dogs:
/tmp $ cd pets/dogs
/tmp/pets/dogs $ mv /tmp/new/S[ca]* .
/tmp/pets/dogs $ ls
Sally  Scout
/tmp/pets/dogs $
```



To verify your answer using Opus, create the same directory structure and test your command

```
# Turning on bash tracing
/tmp/pets/dogs $ set -x
++ echo -ne '\033]0;roddyduk@opus:/tmp/pets/dogs'

/tmp/pets/dogs $ mv /tmp/new/S[ca]* .
+ mv /tmp/new/Sally /tmp/new/Scout .
++ echo -ne '\033]0;roddyduk@opus:/tmp/pets/dogs'

/tmp/pets/dogs $
```

Test 2 Q18 answer

18. What permission is lacking that prevents you from viewing */boot/grub/grub.conf*?

r (read) permission for others

```
/home/cis90/roddyduk $ ls -l /boot/grub/grub.conf
-rw------- 1 root root 865 Jun 17 16:53 /boot/grub/grub.conf
/home/cis90/roddyduk $
```

Test 2 Q18 verification

18. What permission is lacking that prevents you from viewing */boot/grub/grub.conf*?

r (read) permission for others

```
/home/cis90/roddyduk $ cat /boot/grub/grub.conf
cat: /boot/grub/grub.conf: Permission denied
/home/cis90/roddyduk $ touch grub.conf
/home/cis90/roddyduk $ ls -l grub.conf /boot/grub/grub.conf
-rw------- 1 root     root  865 Jun 17 16:53 /boot/grub/grub.conf
-rwxrw-r-- 1 roddyduk cis90   0 Nov 10 07:54 grub.conf
/home/cis90/roddyduk $ chmod u-r grub.conf
/home/cis90/roddyduk $ cat grub.conf /boot/grub/grub.conf
cat: grub.conf: Permission denied
cat: /boot/grub/grub.conf: Permission denied
/home/cis90/roddyduk $ chmod u+r grub.conf
/home/cis90/roddyduk $ cat grub.conf /boot/grub/grub.conf
cat: /boot/grub/grub.conf: Permission denied
/home/cis90/roddyduk $
```

To check your answer using Opus, create your own grub.conf and verify by removing and adding r permission.

Test 2 Q20 answer

20. What single command could be used to mail yourself the misspelled words in all of Shakespeare's sonnets with a subject of “To Review”?

Misspelled words are piped from the stdout of spell into the stdin of mail

option to add subject to mail message

```
spell poems/Shakespeare/* | mail -s "To Review" $LOGNAME
```

expanded by bash shell to include all sonnets

Replaced by bash shell with actual user name

```
$ echo poems/Shakespeare/*
poems/Shakespeare/sonnet1 poems/Shakespeare/sonnet10
poems/Shakespeare/sonnet11 poems/Shakespeare/sonnet15
poems/Shakespeare/sonnet17 poems/Shakespeare/sonnet2
poems/Shakespeare/sonnet26 poems/Shakespeare/sonnet3
poems/Shakespeare/sonnet35 poems/Shakespeare/sonnet4
poems/Shakespeare/sonnet5 poems/Shakespeare/sonnet6
poems/Shakespeare/sonnet7 poems/Shakespeare/sonnet9
poems/Shakespeare/trick2 poems/Shakespeare/words
```

Test 2 Q20 verification

20. What single command could be used to mail yourself the misspelled words in all of Shakespeare's sonnets with a subject of "To Review"?

```
/home/cis90/roddyduk $ spell poems/Shakespeare/* | mail -s "To Review" $LOGNAME
You have mail in /var/spool/mail/roddyduk
/home/cis90/roddyduk $ mail
Mail version 8.1 6/6/93.  Type ? for help.
"/var/spool/mail/roddyduk": 1 message 1 unread
>U  1 roddyduk@opus.cabril  Thu Nov  6 11:41  89/1198  "To Review"
& 1
Message 1:
From roddyduk@opus.cabrillo.edu  Thu Nov  6 11:41:24 2008
Date: Thu, 6 Nov 2008 11:41:24 -0800
From: Duke Roddy <roddyduk@opus.cabrillo.edu>
To: roddyduk@opus.cabrillo.edu
Subject: To Review
```

To check your answer using Opus, issue the command and then read your mail

font reduced so misspelled words fit on slide

```
& x
/home/cis90/roddyduk $
```

Test 2 Q30 answer

30. Issue the following command:

```
ls -l /bin/p[gws]?* > /dev/null
```

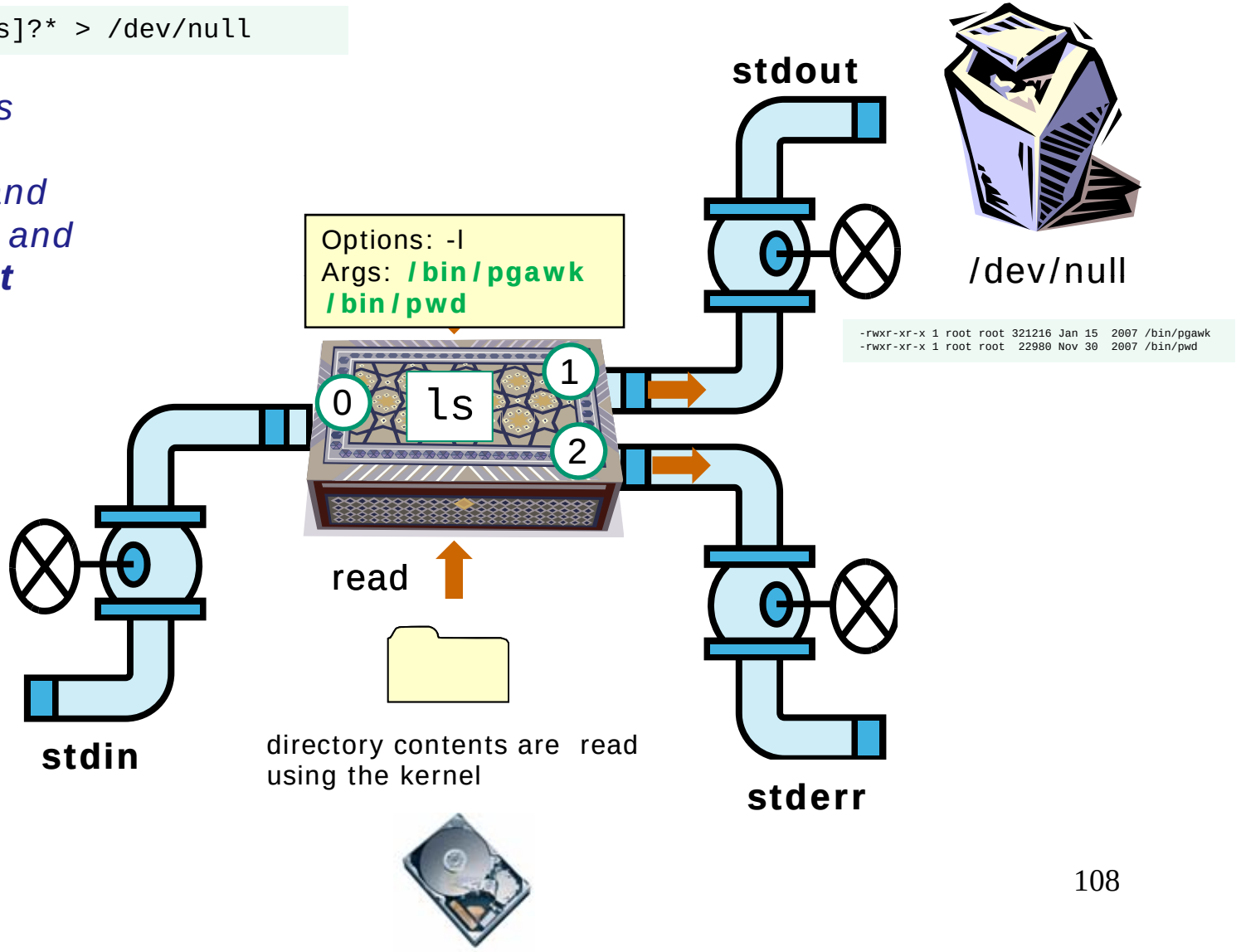
What argument(s) are being passed to the ls command when it is loaded?

/bin/pgawk /bin/pwd

Test 2 Q30 answer

```
$ ls -l /bin/p[gws]?* > /dev/null
```

*Note: ls gets its input from the command line and the OS (kernel) and writes to **stdout** (redirected to /dev/null) and **stderr**.*



Test 2 Q30 verification

30. Issue the following command:
`ls -l /bin/p[gws]?* > /dev/null`
What argument(s) are being passed to the `ls` command when it is loaded?

```
/home/cis90/roddyduk $ echo /bin/p[gws]?*
/bin/pgawk /bin/pwd
```

To verify, use the echo command

or

```
/home/cis90/roddyduk $ set -x
++ echo -ne '\033]0;roddyduk@opus:~'
```

Could also turn on bash tracing

```
/home/cis90/roddyduk $ ls -l /bin/p[gws]?* > /dev/null
+ ls --color=tty -l /bin/pgawk /bin/pwd
++ echo -ne '\033]0;roddyduk@opus:~'

/home/cis90/roddyduk $
```

Signals

SIGSTKFLT	16	Stack fault
SIGCHLD	17	Child process has stopped or exited, changed (POSIX)
SIGCONT	18	Continue executing, if stopped (POSIX)
SIGSTOP	19	Stop executing(can't be caught or ignored) (POSIX)
SIGTSTP	20	Terminal stop signal (POSIX) ***Ctrl-Z or Ctrl-F***
SIGTTIN	21	Background process trying to read, from TTY (POSIX)
SIGTTOU	22	Background process trying to write, to TTY (POSIX)
SIGURG	23	Urgent condition on socket (4.2 BSD)
SIGXCPU	24	CPU limit exceeded (4.2 BSD)
SIGXFSZ	25	File size limit exceeded (4.2 BSD)
SIGVTALRM	26	Virtual alarm clock (4.2 BSD)
SIGPROF	27	Profiling alarm clock (4.2 BSD)
SIGWINCH	28	Window size change (4.3 BSD, Sun)
SIGIO	29	I/O now possible (4.2 BSD)
SIGPWR	30	Power failure restart (System V)

Use kill –l to see all signals

Signals

Use `kill -l` to see all of them

```
/home/cis90/roddyduk $ kill -l
 1) SIGHUP       2) SIGINT       3) SIGQUIT      4) SIGILL
 5) SIGTRAP      6) SIGABRT      7) SIGBUS       8) SIGFPE
 9) SIGKILL     10) SIGUSR1     11) SIGSEGV     12) SIGUSR2
13) SIGPIPE     14) SIGALRM     15) SIGTERM     16) SIGSTKFLT
17) SIGCHLD     18) SIGCONT     19) SIGSTOP     20) SIGTSTP
21) SIGTTIN     22) SIGTTOU     23) SIGURG      24) SIGXCPU
25) SIGXFSZ     26) SIGVTALRM   27) SIGPROF     28) SIGWINCH
29) SIGIO       30) SIGPWR      31) SIGSYS      34) SIGRTMIN
35) SIGRTMIN+1  36) SIGRTMIN+2  37) SIGRTMIN+3  38) SIGRTMIN+4
39) SIGRTMIN+5  40) SIGRTMIN+6  41) SIGRTMIN+7  42) SIGRTMIN+8
43) SIGRTMIN+9  44) SIGRTMIN+10 45) SIGRTMIN+11 46) SIGRTMIN+12
47) SIGRTMIN+13 48) SIGRTMIN+14 49) SIGRTMIN+15 50) SIGRTMAX-14
51) SIGRTMAX-13 52) SIGRTMAX-12 53) SIGRTMAX-11 54) SIGRTMAX-10
55) SIGRTMAX-9  56) SIGRTMAX-8  57) SIGRTMAX-7  58) SIGRTMAX-6
59) SIGRTMAX-5  60) SIGRTMAX-4  61) SIGRTMAX-3  62) SIGRTMAX-2
63) SIGRTMAX-1  64) SIGRTMAX
```